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FACILITIES AND ENVIRONMENTAL EFFECTS  
SURFACE PREPARATION AND COATINGS  
DESIGN/PRODUCTION INTEGRATION  
HUMAN RESOURCE INNOVATION  
MARINE INDUSTRY STANDARDS  
WELDING  
INDUSTRIAL ENGINEERING  
EDUCATION AND TRAINING

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## **THE NATIONAL SHIPBUILDING RESEARCH PROGRAM**

### **Application of Industrial Engineering Techniques to Reduce Workers' Compensation and Environmental Costs - Deliverable F**

U.S. DEPARTMENT OF THE NAVY  
CARDEROCK DIVISION,  
NAVAL SURFACE WARFARE CENTER

in cooperation with  
National Steel and Shipbuilding Company  
San Diego, California

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DELIVERABLE F  
ELECTRICAL DEPARTMENT

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## SUMMARY

The Electrical Department encompasses many areas of Nassco including "Onboard" (both new construction installation and ship repair), "On-Block" ground outfitting, small shop repair services, and Facilities Maintenance.

The Electrical Trade services many areas of the "yard", and work tasks can vary greatly from installing and repairing equipment to pulling yards (actual miles) of cable. Various tasks include layout, installation, cable pulls, hook up, repair, and testing of shipboard equipment.

In order to perform most levels of electrical work, physical requirements such as frequent lifting, carrying, pulling, pushing, standing, climbing ladders, overhead reaching, and manual dexterity are necessary while performing such functions in contorted positions. Many electricians are also certified to weld braces and mounting equipment.

In 1996, a stretching program was instituted in cable crew work areas. The injury rates declined (for a while) following implementation during the first six months of the year, then escalated during the last half of the year. There were seventy sprain and strain injuries during 1996. This amounted to an injury percentage of 127% among a total of fifty-five cable crew employees.

In 1997, the injury rate declined significantly to 3.6%, with fifty-five employees assigned to the cable crew. The current rate is 2.3%, with forty-two employees remaining on the cable crew.

Of the total injuries in the electrical department, nearly seventy-five percent originated within the cable crew. The task of pulling cable is an extremely labor intensive and time consuming process. The amount of manpower utilized to position the cable spools for installation, as well as feed and layout of cable runs, is approximately sixty percent of the pulling process, forty percent of which is dedicated to actual physical labor.

During October 1997, six injuries were reported for the cable crew alone, with no other injuries reported by the electrical department. There were two injuries on the SLNC 1 (Sealift New Construction) and three on SLNC 2 with one injury occurring in a shop area.

Due to these alarming statistics, a process improvement team was established to study prevention measures to help reduce the number of injuries to cable crew employees.

## PARTICIPANTS

Due to the number of escalating injuries on the cable crew and electrical department, Dave Langenhorst, Electrical Department Superintendent selected a Process Improvement Team to investigate solutions to reduce workers compensation costs. The team analyzed injury data and interviewed accident victims, supervisors and others to determine causes and contributing factors to sprain and strain injuries. The team reviewed production procedures, work instructions and tool usage relative to impact on sprain and strain injuries. Other NASSCO departments were consulted when necessary to assist the team in developing solutions. Existing policies, procedures, work instructions and tools were not to be changed without approval of the appropriate managers.

The charter for the Electrical Process Improvement Team was as follows: **To analyze the causes of sprain and strain injuries among electrical employees and to develop methods of prevention.**

The following team members consisted of **Production, Training, Safety and Human Resources:**

Name	Position	Department
Gale Withrow	Electrical Employee Advisor	Electrical
Freddie Hogan	Project Engineer	Human Resources
Mike Yavno	Safety Representative	Safety
Paul Iwane	Production Supervisor	Electrical (Cable Crew)
Ken Henkemeyer	Production Supervisor	Electrical (Cable Crew)
Pete Hall	Working Foreman	Electrical
Jim Ferguson	Industrial Hygienist	Safety
Matt Martin	Working Foreman	Electrical (Cable Crew)
Phyllis Belisle	Training/Dev Specialist	Training

## BACKGROUND

During the first meetings, "PIT" team members reviewed and studied research material pertaining to the nature of sprain and strain injuries. The team was able to determine root causes of back injuries, identify factors (both internal and external) and aggravating conditions that contribute to sprain and strain injuries. Most injuries involve the following dynamics under sprain/strain: surge of effort, beyond range of motion, and biomechanics.

Factors associated with the workplace that were identified as external: cable pulling, lifting objects, tightening nuts/bolts, extended reaching, working in awkward positions and cramped spaces, prolonged effort, walking while carrying weighted and sometimes uneven loads.

Factors that were identified as internal: outside distractions, emotional problems, lack of sufficient rest, lack of training, unwillingness to share the load or effort, physical weakness, body size, pre-existing medical conditions, medication and sedentary lifestyle.

Team members learned from professional speakers and other training presentations that a difference exists in how sprain and strain injuries are classified. Sprains typically involve either the stretching of or the more serious "tearing" of the ligaments, which occur with pain and swelling. Strains usually involve either muscular or ligamentous injury which include symptoms of muscular tenderness and weakness.

As the research process continued, the team reviewed departmental data and analyzed safety statistics regarding monthly injury rates - the number of injuries per month as well as yearly totals. **(Figure 1. Pages 53-56)** The most common injuries were "back" injuries frequently occurring within the "cable crew".

In order for the team to determine the causes of these injuries, explore prevention measures, and make useful recommendations, NASSCO injury data (period from 1995 through December 1997) was thoroughly analyzed. This data was then graphed according to the type of injury, the location in which the injury occurred, and the body part injured.

This helped the team to identify internal and external factors that contributed to back injuries.

Other conditions can contribute to sprain and strain injuries. The following (conditions) were discussed among team members: beyond range of motion, diminished range of motion with age, repetitive motion, inflammation of the tissues (including rare degenerative tissue disorders), and improper body biomechanics.

Team members learned that improper body biomechanics implies improper or poor body positioning or motion.

Another workplace issue was discussed: the relative "inaccessibility" of many work spaces, particularly "on board". By design, many of the workspaces on a ship (especially while under construction) create an environment where safety is always a major concern. Employees "on-board" often work in confined areas and aggravating positions, while performing tasks that involve sudden pulling or twisting, as well as repeated movement or impact. As a result, many experience the effects of overexertion during daily activities in the workplace.

Team members discovered that many retired or ex-military (Navy) personnel are routinely hired at NASSCO. It is assumed that this is because they likely have prior shipboard experience and possess certain knowledge of ships' "on board" systems. However, when company injury data was analyzed, team findings revealed that the "personnel factor" is another issue that raises other questions and concerns about present hiring practices.

A survey was taken and a number of employees from the electrical department were interviewed. The following questions were asked: How long out of military service? How many E-5 and above? How long in trade? Prior injuries? Any warning signs of overexertion? Engage in any stretching or warm-up exercises, either at or away from work? Some additional questions were asked about the type of tasks performed, about safety and about the workplace in general. During this time team members also learned that there is a difference between "stretching exercises" and "warm up".

## DEFINITION OF TERMS

### A. Biomechanics

Those who have taken a physics course learned that "mechanics" involves the analysis of action relative to the science of motion and force. Biomechanics involves the study of the mechanical operation of the human body. It is the science of motion and force in living organisms. The musculoskeletal system of the body provides the foundation data for the study of biomechanics. Understanding biomechanics is important in determining causes of injury. Internal mechanisms, which enable the body to move, provide important information to the study of injury prevention.

In biomechanics, the measurement of primary concern is force. This is especially true as force relates to loads and stresses on the body. Force is defined as that which can cause an acceleration of matter. In biomechanics, there are two categories of force that create motion of biological matter or, in everyday terms, movements like walking or lifting. These two categories are: (1) *load*--the external forces upon a structure or organism, and (2) *stresses*--the internal forces generated in the structure as a result of loading. (**Figure 11. Pages 113-114**)

In the human body, all movement is made possible by the application of load and stress to biological levers. With an awareness of joints, bones, and muscles, biomechanics provides safety professionals with an understanding of how the musculoskeletal levers of the body are designed to work. Knowing how the body is designed to naturally move, professionals can identify and eliminate the unnatural movements that can result in ergonomic problems. Evaluation activities such as monitoring frequency and duration of movement or examination of postures and positions can be initiated to determine the level of ergonomic risk. Internal and external forces should be a part of this evaluation. These activities are performed as part of a job or task analysis.

When twisting or other unnatural movements of these biological levers are observed during a task analysis, they should serve as warning signal. Unnatural physiological movements and postures will eventually result in ergonomic injury. Ease of work activity or biomechanical advantage is only possible when weight is held and moved using the best posture and body position. These best postures and movements are our natural physiological movements.

**Sprains and Strains:** A sprain is an injury to a ligament or a tendon. A strain is an injury to a muscle. All three-ligament, tendons, and muscles-aid in the movement of your joints. A sprain can be much worse, especially if it's a major ligament like the anterior cruciate ligament in the knee. Sprains are most commonly a result of a twisting injury or impact injury

**Muscle strain:** A muscle strain is the term for a moderate amount of damage to muscle fibers. Limited bleeding inside the muscle causes tenderness and swelling, which may be accompanied by painful spasms. Visible bruising may follow. More severe damage that involves a larger number of torn fibers is called a muscle tear.

**Muscle tear:** A torn muscle causes severe pain and swelling. Extensive bleeding may result in the formation of a blood clot, which a doctor may need to remove by needle aspiration or surgical drainage. Vigorous shoulder movements may tear the deltoid or pectoral muscle where it attaches to humerus for example.

**Inflammation:** Swelling of tissues due to irritation of tendon or tendon sheath caused by friction of tendon on bone or tendon sheath.

**Overexertion:** During daily activities, more stress is put on the tissues than they are capable of withstanding. This results in strains and sprains (tears in the muscle, tendon, ligament, and cartilage tissues).

**Sudden pulling or twisting:** Movements also put stress on the tissues. The stress may pull the tissue beyond its ability to stretch. Twisting may force the tissue in a direction it wasn't designed to move. These movements can result in strains and sprains (tears in the muscles and tendons/ligaments).

**Repetitive motion:** Tendons and ligaments rub against adjacent tissues. When this occurs without periods of rest or alternative movements, affected tissues will be irritated. Irritation results in inflammation (swelling) and pressure on adjacent nerves.

**Rotation:** A movement in which a body part turns on its longitudinal axis. The turning of the head is an example of rotation.

**Supination:** The turning of the forearm or wrist such that the hand rotates and the palms are facing upwards.

**Pronation:** The opposite of supination. The turning of the forearm or wrist such that the hand rotates and the palm is facing downwards.

## B. Operational Categories of Movement

Operational Classification of movement refers to the task being performed by the operator at the time of the job observation. The following is a list of the terms used to represent the operational classification of movement.

**Positioning:** This classification involves moving an object and corresponding extremity from one position to another. An example of positioning would be reaching for a bolt stored in a bin at the right of an employee.

**Continuous movement:** A single movement involving muscle control to adjust or guide a machine or other piece of equipment. An example of continuous movement would be the steering of a forklift.

**Manipulative movement:** The handling or assembling of parts. These movement classifications are usually limited to hand or finger movement. An example of manipulative movement would be the assembly of component parts.

**Repetitive movements:** These are the same movements which recur over and over. Hammering or using screwdriver would be examples of repetitive movements.

**Sequential movements:** A series of separate movements that are joined together in a specific order to complete a given task. Reaching for a tool with the right hand, grasping a component in the left hand, moving the two hands toward one another, and adjusting the component using the tool are examples of sequential movements.

**Static movements:** Maintaining the position of a body member in order to hold something in place. Though movement may not be involved, the muscles are required to maintain the steady position of the object. Holding a board or plaster board in place on the ceiling of a room while screwing it into position is an example of static loading of muscle groups or static movements.

### **C. Historical Analysis of Low back pain**

Low back pain is one of the most common ills of mankind. Four out of five people will experience low back pain sometime during their lifetime. After the common cold, problems with the lower back are the most frequent cause of lost work time in adults under the age of forty-five. Economic losses because of back pain have been estimated to total \$16 billion annually.

Fatigue and strain are the most common causes of low back pain. About sixty percent are from overexertion. The lower back or "lumbar spine" is where most people experience pain. The lumbar spine supports seventy-five percent of your weight. While not a direct cause of low back pain, emotional problems or stress-related tensions can aggravate back pain. A person with low back pain who is emotionally upset or stressed will often be very tense. Tension can increase muscle spasms in the back. These spasms lead to more pain, which itself causes the muscles to "tighten" or become tense.

#### **1. What causes low back pain?**

##### **A. Mechanical problems**

Pain in the lower back often has one or more of the following causes: poor posture, poor physical fitness, poor work habits, lack of regular exercise, obesity, or poor sleeping habits such as sleeping on the stomach.

##### **B. Injury**

Injuries caused by lifting heavy objects, falling, motor vehicle accidents, and sports activities are common causes of low back pain. Lifting injuries are the most avoidable. Bending the knees while lifting objects can prevent many.

##### **C. Acquired conditions**

Low back pain as well as leg pain can be caused by spondylitis, a condition in which bone does not form completely in the lower spine, causing one vertebra to slip onto another. This condition affects as much as 2% to 3% of the population. Other conditions that occur during life such as arthritis and osteoporosis (porous bone) are frequent causes of low back pain in older age groups.

##### **D. Infection**

Infection involving the vertebrae or the connective tissues between them may occasionally cause severe low back pain. These infections are treated with antibiotics, and sometimes surgery. They can cause damage to the vertebrae that may

require a long recovery period.

2. **Other common causes of back pain**

- a. **Over exertion** - Over-doing activities you normally don't do.
- b. **Muscle Spasms** - Strong, painful contraction of the muscles.
- c. **Overload injuries** - Lifting more weight than you should.
- d. **Posture** - Poor posture can contribute to back pain.
- e. **Lifestyle changes** - A decrease in activity level may contribute to back pain.
- f. **Emotional stress** - Stress causes the muscles to contract.
- g. **Pre-existing conditions** - Physical conditions such as Scoliosis, Spondylitis, Spinal Bifida, or Arthritis may cause back pain.
- h. **Ruptured Disc** - The most common, serious cause of back pain.

## D. Cable Pulling Process

### 1. Preparation

- A. Cable runs are measured using route sheets, blue prints and the latest ECN's.
  - 1. Check for accuracy
  - 2. Location of equipment moved
  - 3. Change of cable types or deletion of cable
- B. Cable order is sent to vendor where cables are cut and delivered to NASSCO on specific dates.
- C. Scaffolding is installed and secured along completed cable run, prior to commencing installation.
- D. Cable pulling machinery (chugger) is set up at logical pullout points

### 2. Installation Procedures

Cable is installed by Work Teams strategically located (approximately eight employees).

- A. On the Deck (four employees).
  - 1. Turning cable reel (two employees)
  - 2. Laying cable uniformly on deck (two employees)
- B. On Scaffolding (two employees)
  - 1. Lubricating cable (one employee)
  - 2. Following end of cable through wireway (one employee)
- C. On Deck, at pull-out point (two employees)
  - 1. Chugger operator
  - 2. Laying cable uniformly on deck (one employee)
- D. Once cable reaches destination location, excessive lengths are cut and information is reported to cable tracker.

**Note:** To insure that proper cable lengths are accurately placed near equipment locations, one employee is assigned to "map and measure" correct cable lengths at

equipment destinations.

## **E. Team Activities**

### **Brainstorming**

During the early team meetings, many ideas were presented and analyzed as possible injury prevention factors. Using the technique of "brainstorming", the team was able to identify a number of conditions and focus on key issues that became the source for a formal investigation. Many ideas and recommendations continued to surface throughout the investigations. In order to reach a viable solution to the "assigned" problem, the team used a "filtering process" to maximize time and effort. The team consulted with production supervisors (both salaried and hourly) because of their specialized knowledge working with a number of employees who had been injured on the job. Because the supervisors witnessed and often tried to prevent many of the accidents and injuries to these employees, their suggestions were carefully considered.

**Because of the team's injury prevention investigation, it was agreed that the following suggestions should serve as a purposeful course of action:**

Warm - up vs. Stretching

Backbrace (use of) - Positives vs. Negatives

Back Injuries (possible causes)

Poor Posture

Improper Body Position

Overexertion

Job Assignment

Behavior

System of Tracking and Transferring Employees (from one supervisor to another)

Utilizing "People Soft" Program for Tracking (above) (NASSCO HRIS)

Observation Program

Employee Survey

Attitude (behavior)

Environment

Incorporate "Therapy Specialists" recommendations

As team members visited job sites "onboard" to evaluate the work environment, cable crew employees were observed in the cable pulling process. Team members observed that employees larger than the average size (in height and weight) were placed forward, or in front of the cable, to unreel, flake out, feed and guide large cable into a tray up into main wireway's. Smaller cable crew employees were placed further downline of the cable during the pulling process. Team members discovered that the larger cable pulleys were usually injured first and more frequently, especially when they were required to pull cable in tight or confined areas of the ship. The injuries frequently occurred in the machinery rooms, engine rooms and switchboard compartments.

Because of the type of ships that NASSCO is building, approximately forty-eight percent of all cable installation requires T-400 cable, with the remaining installation requiring T-300 cable and smaller. Fifty-five percent of T-400 cable is installed in engine room spaces, while forty-five percent is installed in the cargo and house areas. The process of installing smaller cable is not as labor intensive as the process of pulling large T-400 cable. In many cases only two employees are required to install small or "local cable", depending upon the location and the amount of obstructions. Upon further review and analysis of injury data, team members discovered that the frequent injuries to cable crew employees, who had large body frames, occurred as a result of pulling large T-400 cable while working in cramped and contorted positions inside engine rooms and tight spaces in cargo holds. T-400 cable weighs approximately six pounds per foot with a circumference of three inches and is difficult to grasp and pull. Attempting to overcome fatigue and reduce the stress of impacted areas of the body such as the hands, arms and shoulders, cable crew electricians are encouraged to take brief rest periods to "recuperate".

Assigning a larger than average size employee the task of pulling or handling T-400 cable while having to work in a contorted position inside a confined space or cramped area with previously installed equipment, is viewed by team members as an "accident waiting to happen". The inaccessibility of ladders and scaffolding raised additional concerns in regard to other safety hazards, such as slipping and falling. In recognizing these potential hazards, the process improvement team made additional suggestions in regard to shipboard design and fabrication. The team decided to document all concerns and relay them to the Engineering Department through Electrical Superintendent Dave Langenhorst.

Team member Ken Henkemeyer held a discussion with two of the local subcontractors currently with NASSCO to obtain information about injury rates in their organizations. Both Hopeman Bros. and PCI have consistently had low injury rates in comparison to NASSCO over the past few years.

**The subcontractors provided the following information:**

1. Commitment to Safety vs. Production. Safety is part of the "Operating Philosophy" of both companies.
2. Regular Safety Meetings
3. Use of Back Belts as well as Pre-Briefing on Jobs involving Lifting and / or Moving Equipment.
4. "Stop" (Anonymous) Observation Cycle Program (Hopeman Bros.)
  - (a) Focus on Trends (Daily)
  - (b) Active Correction vs. Accident System
  - (c) Immediate Attention/Response to Potential Accident Situations
  - (d) More Emphasis on Accountability vs. Written Warning

## **F. Warm-up vs. Stretching**

Production Supervisors explained to team members that, although a stretching program had been instituted, the program is not mandatory for the employees. They also noted that there had been minor reduction in the number of injuries, especially in the "On-block" area. The program is available (or is required) with the consent of the production supervisor of each group designated to participate. The individual assigned to "lead" the employees performing stretching exercises must follow the guidelines and precautions stated in the outline of the program. There can be no exception to this requirement.

### **1. Distinction between Stretching and Exercise**

Exercise is designed to warm up the muscles and tendons and to increase blood flow. It is also designed to strengthen muscles. While desirable, it is not the goal of this program to lead employees in this type of activity. The best form of warm up is to perform work activity itself. The employee must begin slowly and build up his or her level of activity as their body permits.

Stretching is designed to maintain or increase an individual's flexibility and range of motion. Why is this important? Because, a large number of musculoskeletal injuries occur when individuals exceed their level of flexibility and range of motion. Thus, anything that can be done to maintain good flexibility or improve limited flexibility is helpful in preventing damage to these tissues.

### **2. Words of Caution**

Stretching is best done when the muscles, tendons, joints, etc. are warm and have good blood flow. These tissues are more pliable or elastic when warm.

The individual may risk tearing or straining these tissues when they are cold and stiff. Some recommendations to overcome the coldness and stiffness prior to stretching: move around-get the blood flowing, move your arms, legs, and torso without challenging the limits of your range of motion.

It is not intended that this program result in vigorous movement of any type. It is important that individuals learn to "listen" to their bodies and to recognize when it is warning them against performing certain functions and when it is giving them permission to go ahead with an activity.

The body movements are to be gentle in nature and such that each

individual gently tests his or her limits of flexibility and range of motion with an easy stretch. After holding the easy stretch, test the body's willingness to go to a fraction of an inch further.

Only with the permission of their body should an individual extend the movements that bring on mild discomfort. This extended stretch is called the developmental stretch. Remember the adages of "mind over matter" and "no pain, no gain" do not apply to us when stretching.

Sensible stretching does not involve any "pumping" or "jerking" movement. We have all seen people do this, but those who engage in these types of movements while stretching are using poor techniques that can and probably will lead to injury.

## **G. Backbrace (Positives vs. Negatives)**

Issues concerning the use of backbelts was hotly debated among PIT team Safety representatives. Their contention was that back "support" belts don't prevent back injuries. However, remaining team members learned that many of the local subcontractors (who were using back belts) had experienced an overall reduction in their injury rates, and adamantly insisted upon sponsoring a "pilot" program to test the belts. They could then find out what benefit, if any was to be derived from using them. The team unanimously voted to select two crews in the Electrical Department to participate in a back safety study, which included a pilot program to test the belts. Dayshift cable crew employees were selected to test the belts because it was more convenient for the dayshift production supervisor to monitor the employees using the belts and to provide a fair accurate evaluation.

In order to obtain fair, accurate data from the testing, the team used the following criteria: **Commitment, Identification, Availability, Training, Medical Surveillance and Ergonomic Evaluation.**

**Commitment:** A pro-active commitment to reducing back-related injuries is the most important element of a successful program. A Win/Win decision.

This commitment must start at the top of the company and organization and must be transmitted to every employee.

**Identification:** Identify the kind of job that often contributes to lower back injury. Identify tasks where frequency, bulk and weight exceed NIOSH targets. Identify individuals, who have suffered a previous back injury, they are four times more likely to re-injure themselves than those who have not had a previous back problem.

**Availability:** Make backbelts available to those individuals who would like to use them. Allow individuals to choose between 2 or more backbelt models, so their personal needs are met, and their "buy-in to the program is present.

**Training:** Employees need to know a Back belt can lessen the risk of injury by reducing unwanted muscle contraction. By reducing unwanted muscle hypertonicity, a back belt can maintain the lower lordotic curve of the lower back, desirable in lifting and seated postures. They need to know a backbelt will not weaken muscles, because it doesn't deny range of motion or do the work of the muscle groups. In addition, it won't help anyone do anything extraordinary.

Each belt should be labeled as such, to prevent misunderstandings. Sessions on safe lifting techniques, physical conditioning, and the benefits of good posture are all part of ongoing training.

**Ergonomic Evaluation:** Establish a task force, develop action plan, analyze work site and work practices, assess employee capabilities, define possible changes, prioritize actions, and measure results. The evaluation should involve the input of all employees. (Figure 10. Page 107)

**Medical Surveillance:** Individual physical capabilities should be determined to establish if they are able to perform specific tasks over the expected duration.

As indicated by research recently conducted, there is an apparent lack of consistent application regarding evaluation criteria. (Figure 8. Cal-Osha Report dated 9/8/97 page 103). Bias becomes quickly evident. We must evaluate information carefully, perhaps seeking assistance when attempting to understand data and conclusions.

In a recent summary of positive and negative studies on back supports, the reviewer notes that he did not include many studies in his paper because they have no matched control group, no post-trial sample size, etc. Yet, in the clinical trials cited, virtually none of these criteria is met.

Apparently, there was no scrutiny of practical issues, such as the appropriateness of wide, stiff belts worn by workers while loading luggage in a forty-two inch fuselage of an airplane. The researcher in that study indicates 58% of the workers discontinued wearing the belt prior to the end of the project. We constantly hear this study cited as a case against back supports. Shouldn't the conclusion be that certain styles of belts are not appropriate in certain situations. Training should include a choice of belt to use. Isn't that true of hearing protectors, safety shoes, and respirators?

For example, hard hats can't really prevent many injuries by themselves. A "Hard Hat Area" program prevents tools and material from falling, makes head height obstacles avoidable, and prominently displays signs to alert potential danger and remind people to follow the rules. A "Hard Hat" alone does not prevent head injuries, as well as an implemented comprehensive program.

## **METHODOLOGY**

### **A. Analysis of Injuries/Analysis of Charts**

The following is actual information obtained from FROI report (First Report of Injury) data, based on actual dates of injuries over the past year in the Electrical Dept., which indicate that:

1. Number of injuries was high on the first and second days following a holiday.
2. A significant number of injuries occurred in the middle of the week on Wednesdays.
3. Number of injuries was lower on the day before a holiday.
4. Most injuries occurred among new hires in the department.
5. Repeat injuries were low - approximately one quarter of those injured was repeat/multiple injuries.

#### **Possible Causes Noted:**

1. Before a Holiday
  - (a) General Job Duties - different (usually clean-up)
  - (b) Mind set is different- getting ready for the holiday
2. Following a Holiday
  - (a) Exhausted from holiday
  - (b) Different mental attitude
  - (c) Not focused on job
  - (d) Possible injury at home on the weekend
  - (e) Holiday activities were not relaxing
3. Wednesdays
  - (a) More tired- middle of the week
  - (b) Need to often "pick up the pace"- "Hump Day"

In order to put together a survey that would effectively get to the root causes of these injuries, the team compiled an additional list of known conditions of back strain and/or sprain. After compiling the list, the team grouped the conditions into the following categories: **Beyond Control Issues, Employee Controlled Actions/Activities, Management Controlled Issues, Mental Factors, Physical Factors (Body), training.**

#### Beyond Control Issues

- Age
- Body Size
- Posture

#### Employee Controlled Actions/Activities

- Attitude/Behavior
- Battle fatigue
- Conditioning/Exercise
- Improper clothing
- Lifestyle
- Outside Distractions
- Overall Fitness
- Second Shift Prior Activities
- Stress (mental)
- Tired
- Value System

#### Management Controlled Issues

- Changes in circumstances
- Environment
- Hiring practices
- Job assignment
- Lack of consistent approach to training and orientation
- No penalty for bad safety numbers
- Technology
- Trying to make a good impression

#### Mental Factors

- Attitude / Behavior
- Inside distractions
- Lifestyle
- Morale
- Past practices
- Responsibility/Accountability issues
- Stress (mental)

Unfocused  
Physical Factors (Body)  
Awkward position  
Beyond range of motion  
Bio-mechanical  
Body changes  
Extended reaching  
Improper /Sudden body movement  
Over exertion  
Physical Condition  
Prolonged effort without rest  
Repetitive motion  
Stress (physical)  
Surge of effort  
Tightness  
Unequal forces  
Weight distribution

#### Training

Awareness  
Don't know the Consequences  
Inadequate or Lack of Training  
Time in Trade

## **B. Questionnaire**

After identifying additional conditions of back injuries, the team decided by weighted vote to formulate questions that matched the Six categories. The categories are: **Beyond Control Issues, Employee Controlled Actions/Activities, Management Controlled Issues, Mental Factors, Physical Factors (Body), Training.**

Next, the team decided which groups of employees and how many would be interviewed. The decision was made to interview five employees with records of multiple injuries. These employees would be the group to test the validity of the questionnaire. The team then drafted a questionnaire limited to fifteen questions. Interviews were not to exceed thirty minutes, so that interest would not be lost. If any changes were to be made before further interviewing, a vote would have to be taken. Team members decided that "open ended" type questions would be best to promote honesty and possibly obtain additional information that might be useful. The "team" concept of decision making and problem solving helped to bring issues to the surface, which hadn't been previously thought of, especially during the interview process.

The advantage of "open ended" questions is that they encourage employees to open and reveal their personal thoughts and issues to the interviewer that they may not otherwise talk about with their supervisors. This happened with most employees during the interview process.

Before the interviews were conducted, team members also took part in interviewing skill training to effectively gain information.

### **The following is a outline of the team training process:**

#### **1. Interview Techniques**

- a. Build Rapport
- b. Introduce the Interview
- b. Open-ended Questions
- c. Probe
- d. Allow for Silence
- e. Seek Contrary Information
- f. Control the Interview

g. Take Notes

## 2. Probing

### A. Nudging Probe:

1. I see
2. Go on
3. then?

### B. Clearinghouse Probe:

1. Have I missed anything you can think of?
2. What have I not asked that might be of importance?
3. Is there anything else you'd like to add?

### C. Informational Probe:

1. Tell me about.....
2. What happened after....
3. How did you respond to...
4. Why do you feel that way?
5. I'm not sure I understand your point.

### D. Reflective Probe:

1. Reflects answer in order to clarify and verify it
2. Was that net or gross income?
3. Then, you are going to support this proposal?
4. You mean\_\_\_\_\_don't you?

### E. Mirror or Summary Probe:

1. Confirm understanding and meaning
2. Summarizes a series of answers

### F. Nonverbal Communication

1. Making direct eye contact
2. Avoiding eye contact
3. Shaking head
4. Yawning

5. Patting on the back
6. Scratching the head
7. Smiling
8. Biting the lip
9. Tapping feet
10. Folding arms
11. Raising eyebrows
12. Narrowing eyes
13. Flaring Nostrils
14. Wringing hands
15. Leaning forward
16. Slouching in seat
17. Sitting on the edge of seat
18. Hunching over
19. Having erect posture

#### **G. Interview Format**

1. Preparation
2. Rapport Building
3. Introduce the Interview
4. Body of the Interview
5. Inform
6. Answer Applicant's Questions
7. Close the Interview
8. Rate and Evaluate

## **I. Electrical Safety Questionnaire**

1. How has training (in proper lifting, pulling, and material handling) by your supervisor or any other manager helped you perform your job or affected your work habits?  
.....  
.....
2. How do you know when you're involved in a potentially dangerous situation or work task?  
.....  
.....
3. Have you taken part in a stretching program? If yes, do you feel it was effective in preventing strains and sprains?  
.....  
.....
4. Do you sometimes feel physically tired or have muscle or tendon stress because of continuous physical activity?  
.....  
.....
5. Do you pace yourself when you work and use your downtime to counter stretch?  
.....  
.....
6. Are you easily or often distracted on the job?  
.....  
.....
7. Would you use a back belt if it were provided? Why or why not?  
.....  
.....
8. Do you feel comfortable telling co-workers from another trades when they are about to do something unsafe? If not, why?  
.....  
.....
9. How does it make you feel if a supervisor from another trade tells you when you are about to do something unsafe?  
.....  
.....
10. Do you believe that upper management is concerned with preventing injuries to employees or just in decreasing accident rate numbers?  
.....  
.....

11. Do you think all departments and trades share the same goals when it comes to safety? .....
12. Do you have any reluctance to report and injury? If so, explain. ....
13. What three things should NASSCO's Electrical Department employees do that could reduce back, muscle and tendon injuries? .....
14. How does personal responsibility play a role in preventing injuries? .....
15. If you had an opportunity to change the present safety culture at NASSCO would you become involved in the process? .....

**Additional interviewer's comments:** .....

**Interviewer** \_\_\_\_\_ **Date** \_\_\_\_\_

### C. Interview Results

1. All 17 said "Safety Grams"
2. (Figure 2.page 57)
3. 13.....Yes / 4....No
4. 14.....Yes / 3....No
5. 11.....Yes / 6....No
6. 12.....No / 5....sometimes
7. 9.....Yes / 8.....No
8. 11....Yes / 3.....No.....1....sometimes
9. 15....Positive Response, 2 Negative Response
10. 7....upper mgmt....3..No's only, 5..both true, 2..don't know
11. 9.....Yes, 7.....No, 1....don't know
12. 12...Yes, 5...No.
13. (Figure 2. page 58)
14. (Figure 2. page 59)
15. 17....Yes

#### **D. Analysis of Questionnaire**

After the first five employees were interviewed, the questionnaire was reviewed again to validate information and check for response accuracy. The first five employees were not only candid in their responses to the interview questions, but also were helpful in suggesting solutions to the problems. An additional twelve employees, who had been injured while working on the cable crew, were then interviewed. Individual employees were interviewed by two salaried team members, with an hourly employee observer present to help prevent possible intimidation as well as response bias.

This second group of interviewees was very helpful providing solutions and readily volunteering to assist team in any way possible. Using the "behavioral" approach to interviewing, team members discovered that most employees are very conscientious about safety on the job and possess a strong desire to participate in company decision making. Promoting the "team concept" whereby employees become directly involved in problem solving and injury prevention is nothing new to the industry. The Japanese were the first to use Doctor W. Edwards Deming's concept of this "team" approach to problem solving from the bottom up.

In order to solicit accurate, honest answers to the questions, it is very important to elicit employee "buy in" to be successful in the interviewing process. During the interviews, employees were reminded that their responses were recorded only to assist the injury prevention action team and not for future retribution or disciplinary action. These employees were encouraged to provide input for team recommendations and solutions. It is apparent that when employees are able to contribute to the decision making process with regard to safety, they tend to have a higher level of awareness about their safety and welfare on the job and be supportive of final recommendations.

The top responses from the employees off the questionnaires were: a stretching program or pre-work warm-up prior to cable pulling, the use of back belts, and training to enforce the message of back safety on a regular basis. Most of the employees had attended some form of back injury prevention training, but the message was not enforced on a daily basis. Examples under "not being enforced": immediate supervisors do not stress the importance of safety awareness enough, the five minute safety meetings emphasizing back injury prevention are too infrequent, first line supervision is not provided with an adequate "employee history" for individual transfer employees, information about prospective employees is poorly communicated, and production takes priority over safety.

Issues concerning "lifestyle change" often surfaced during the interviews. It was discovered that many "production" employees do not engage in regular "physical" activities following working hours that could help them remain "physically fit". It was noted that poor diet, lack of sleep or improper amount of rest, and the inability to fully recuperate before returning to a normal workday were some of the major causes of injuries. There is strong evidence to support the need for some type of after work wellness program. This could involve going to a gym, engaging in routine exercises at home, playing sports, or simply stretching to alleviate muscle tension and tightness. This is especially important for the retired military employee who may lead a more "sedentary lifestyle".

Smoking and overeating are also negative factors that increase the tendency for work related injuries. This is especially true with work that is entirely "physical" by nature, such as cable pulling. Smoking restricts blood flow and oxygen to the lungs, making it difficult to work for extended periods without resting. Cable crew employees take regular rest periods to compensate for fatigue, but when smoking is coupled with this high level of physical effort, the possibility of injury increases.

Maintaining a proper diet is paramount because nutrition is important to the effective working order of the human body. Some of the employees interviewed were aware of the role proper nutrition plays in preventing injuries. Overeating should be avoided. Obesity can cause physical limitations when pulling cable in restricted areas and where pulling requires the employee to work in contorted positions. Without proper nutrition, energy levels for the physical demands of the trade can not be properly met and the employee may further subject him or herself to back injuries.

The purpose of the survey (questionnaire) was not only to help the injury prevention action team understand why employees become injured, but also to learn how to change "behavior" that causes injuries. Tools, equipment, and aspects of supervision can be corrected, but if the employee is not properly trained, or his/her behavior does not change, the injuries will continue to occur.

The "process approach" to injury prevention can be used in a program that is designed to promote behavioral change and reduce injuries by braking the "accident cycle". Some fundamentals include:

1. Employee involvement.
2. Operational definitions and measurement systems.
3. Positive charted verbal feedback.
4. Upstream performance measurements.
5. Proactive intervention

All employees share equal responsibility in the process. Behavior or "actions" which are "observable" are both manageable and measurable. The goal is to change "antecedent behavior" using a proactive approach - to "stop" before an accident happens. This is a purely "preemptive" approach. Applying this process includes:

1. Identifying critical safety related behaviors in operationally defined terms.
2. Training people to be observers to gather data - to observe safe and unsafe behaviors, then provide feedback.
3. A systematic ongoing and continuous improvement observation process in which observation data is used for problem solving and continuous improvement. Ultimately to create a culture where "safe behavior" is expected.

It is recognized that Management and Employee "buy-in" is important for successful implementation and requires addressing cultural barriers. Overcoming cultural barriers is essential for successful implementation.

## TRAINING

### A. Industrial Hygienist

James Ferguson, NASSCO's Industrial Hygienist gave the team a training session on soft tissue injuries. The training consisted of defining sprains and strains, and prevention measures needed to avoid injuries. A sprain is an injury to a ligament or a tendon. A strain is an injury to a muscle. All three-ligament, tendons, and muscles aid in the movement of your joints. A sprain can be much worse, especially if it's a major ligament like the anterior cruciate ligament in the knee. Sprains are most commonly a result of a twisting or impact injury.

He noted that: you should be in good shape, train properly, and always stretch before exercising, especially as you get older and your tissue gets tighter. It is also important to learn your body's limits and how much you can tolerate without injury. Take it slow, it is easy to get over-involved in any activity, whether it's weight lifting or gardening, and always be sure to use proper technique, knowing the right way to pick up heavy objects. He also noted causes of injury: **Overexertion during daily activities, Sudden pulling or twisting movements, Repeated movement or impact, Repetitive motion, Rare degenerate tissue disorders.**

**He also discussed low back pain in great detail which include the following prevention measures:**

1. Getting regular exercise.
2. Sit with knees higher than your hips
3. Practicing good posture
4. Push don't pull loads
5. Lifting only light loads.
6. Keep loads close to your body when lifting
7. Doing specific back exercises

## 8. Managing your stress

**Some of the treatment methods discussed were:**

1. Rest and relaxation will help relieve back pain.
2. Heat and massage can help relax muscles.
3. Cold can help reduce pain and swelling.
4. Anti-inflammatory such as ibuprofen or aspirin can help reduce inflammation.
5. If back pain persists, see your doctor. If you feel weakness, numbness, or pain in your legs, make an appointment to see your doctor.

## B. Therapy Specialists

Therapy Specialists is a team of healthcare providers subcontracted by NASSCO to treat qualifying workers compensation injuries that require physical therapy. Jeannette Barrack, a physical therapist from this group, was invited to speak to the team about the causes of sprain and strain injuries, where they can most likely occur, and how to prevent them. She also discussed the common types of therapy her facility uses to treat these injuries and illustrated some useful techniques to prevent low back injuries.

### **Therapy Specialists' Theories on Causes noted:**

1. Stressful, awkward positions
2. Improper body movement (example pulling & twisting)
3. Body mechanics
4. Body changes
5. Unequal forces on the Body
6. Unequal weight distribution
7. Lack of exercise, fitness and/or proper conditioning
8. Body size, makeup
9. Poor posture
10. Tightness in certain areas of the body
11. Performing strenuous activities before stretching or "warming up".
12. No specific stability program for improvement
13. Lack of change in daily activities
14. Lack of individual awareness and or training about injury
15. Prevention with respect to all of the above.

She explained that, while workers generally respond well to treatment after being injured on the job and do show they wish to "get well" so that they can "return to work", it is believed that workers often "set themselves up" for injuries. She also presented some helpful Techniques/Practices to prevent injuries such as: **Neutral Back**- Body Position, **Hinging**- For different movements (risks involved if not performed correctly), **Bracing** - Specific areas ( legs, muscles, abdominal area).

### **Therapy Specialists' Treatment approach is as follows:**

1. Localize the injured area and treat.
2. Stress on becoming fit as well as using the above techniques.
3. Retraining pressure so muscles can heal faster.
4. Encourage change (even 20% to reduce potential for injury)
5. Gentle stretching during healing process.

They also recommended using back belts, if worn properly. Before the back belt testing began, the team invited Therapy Specialists to perform "on site" training for the two groups of employees who were chosen to participate in the back belt "pilot" program. Employees were split into two groups of ten. Both groups were to receive training on how to properly use a back brace or "belt". However, only the first group of employees would actually wear the back belts while pulling cable. The second group would not wear back supports to pull cable.

The following is the outline used by Therapy Specialists to train the cable crew employees:

- I. Back Education Training Program (Figure 3. Pages 60-67)**
2. Information, general knowledge about the back, how the back works. (overhead visuals, see appendix)
  1. Anatomy of the back
    1. overview
    2. The Natural Curves
    3. Proper alignment of the spine
    4. The spine as a Bio-mechanical lever
  2. Physiological Aspects (Kinesiology)
    1. The mechanics of Good Posture
    2. Postural Balance- For efficient muscle performance  
For smooth controlled motion  
Crucial to movement
  3. Important Concepts
    1. Neutral Back
    2. Hinging
    3. Bracing
3. Contributing causes of Back Injury
  1. Sprains and Strains
    1. Lifting, Twisting, Bending Incorrectly
    2. Poor Posture
    3. Fatigue
    4. Accidents
    5. Sports Related Injuries
    6. Diet
    7. Generic Predisposition
    8. Heel Strike

4. Safe Lifting Techniques
  1. Why it is Important to Practice Correct Methods of Lifting.
  2. How to lift better, What works
  3. "The Lighter Side of Lifting" (Video Presentation)
    1. Prepare for the lift
    2. Keeping the Curves---Keeping the Natural Curves of the spine
    3. Maintain a safe Lifting Range- Keep the load Close or Center of Gravity over the Load.
    4. Use a Staggered Stance - Provides a Wider Base of support using legs.
    5. Shoulders over the hips- significantly less demanding of the lower back.
4. Conditioning and Healthy Behaviors
5. Warm up
  1. Reduces risk of injury
  2. Improves performance
6. Stretching
  1. For Increased Flexibility
  2. Heightened Level of Endurance
7. Benefits of Behavioral Change to Improve Overall Fitness
  1. Change in daily Activities
  2. Importance of Regular Exercise
  3. Importance of Maintaining a Healthy Diet.
8. Final Summary - Closing Comments
  1. Stressed Outside exercise programs
  2. "When you bend over to pick up something light, and your back goes out, it's just a culmination of all the improper techniques prior to this injury".

### C. Fisher Safety Co. E.L.A.T.E Program

Fisher Safety Co. was contacted to provide back belts for the pilot program. Fisher had been contacted on a prior occasion to provide samples of new back belts that contained air bladders. These new belts, once filled with air, would seat firmly in the contour of the lower back providing comfort and ease to the wearer. The team decided to test these new belts and work closely with the manufacturer in monitoring the effectiveness of the belts. Design changes would be considered, if necessary, to meet production requirements. One major concern with the test model was whether the material was sufficiently damage resistant to withstand the rigors of daily wear while pulling cable in and around machinery.

Pam Tappan from Fisher Safety Co. took the preliminary feedback to the manufacturer (Safeguard Technologies), and they produced a belt that complied with the standards above. (**Figure 4.page 68**) These belts were produced with a more durable nylon fabric, including the necessary Fire retardant material. The belts included optional leather fasteners. The team decided that the test and trial period should last for three months, in order to obtain accurate and unbiased data. During this period, the team reviewed and modified the New **E.L.A.T.E.** back injury prevention program. The **E.L.A.T.E.** program is designed to work in conjunction with the Air Belt. Pam provided data to show that this program has been very successful in other companies. **The E.L.A.T.E. Program stands for Ergonomics, Lifting, Anatomy, Training, and Education.**

The **E.L.A.T.E** training program covered the following topics: (**Figure 5.pages 69-89**)

1. The financial impact of back injury.
2. Contributing factors.
3. Ergonomic intervention.
4. Anatomy of your back.
5. Training for Safeguard's back supports.
6. Lifting and exercise techniques.

"E.L.A.T.E." became the main training resource for the Electrical Department Injury Prevention Action Team (E.D.I.P.A.T.) Back Belt Program. Although, the training package did require some tailoring to meet specific training needs of the cable crew members participating in the pilot program, team members agreed that only specific modules needed to be "customized" in order to meet (planned objectives) of the program. All twenty-cable pullers in the pilot program received special training given by Jeannette Barrack from Therapy Specialists. The two-hour training presentation included back education training, safe-lifting techniques, and recommended exercises from lecture materials, overhead visuals, and video presentations.

**D. Video Presentation: "On the Road, The Lighter Side of Lifting."**

Prior to testing the back belts, the team reviewed several videos of safe lifting practices. In the video presentation of "On the Road, The Lighter Side of Lifting," some of the most effective techniques for safe lifting were demonstrated. Similar methods that protect the back by limiting and distributing stress and exertion were also demonstrated.

The video presentation became the final viewing requirement for the training program. Both Electrical and Steel Erection PIT Teams incorporated the safe lifting methods (demonstrated in the video) into their safety improvement training programs. This video provides a common sense approach to lifting that encourages employees to think about lifting practices on a regular basis.

The information and techniques on this video is as follows: (**Figure 6.pages 90-100**)

1. **Show various types of lifting activities and how approach can alter strength, back stress, and efficiency.**
2. **Motivates workers to think before they lift any object, whether heavy or light.**
3. **Stresses the need for staying attuned to body position and work environment as a way of protecting the back.**
4. **Gives you the chance to explain your policies on lifting and to discuss use of back supports, equipment, or other assistance you offer.**
5. **Can be used for training new employees and for refresher training.**
6. **Explains a better way to lift that stresses weight distribution, stance, and warming up and relaxing.**

## ANALYSIS OF TESTING

### A. Test Group

During the period, employees were closely monitored by their badge number and when transferred - from one supervisor to another. Upon completion of the program, the employees were given questionnaires and surveyed again in order for the team to solicit feedback about whether the back belt should be required for the whole department. After three month of testing, no injuries were incurred among cable crew employees. Those who completed the training but did not wear the belts also remained injury free during this test period.

Though there was not enough evidence to either prove or disprove that the back belt (supports) actually "prevented" back injuries, both test groups believed that the belts could be effective in a more "comprehensive" safety program. From this feedback, and the results of the test program, team members concluded that "education" is the key to success of any injury prevention program. A well-informed employee, who is properly trained to use effective prevention techniques, can significantly minimize the risk of being injured.

There seems to be an increase in the number of workers who rely on back support belts to prevent lower back injuries while lifting. However, after carefully reviewing scientific literature, company surveys and other studies, the team found insufficient data to conclude that these "support" belts actually minimized the risk of back injury. Moreover, because workers think they're protected, they may attempt to lift even more when using these belts, subjecting them to even greater risk. Workers should be taught to use the stomach (rather than back) muscles when lifting.

In order to accurately weigh the benefits as well as possible disadvantages of wearing back belts, a more comprehensive study is needed. Because of design flaws, or the failure to correctly identify a special or "unique" problem in the workplace, some studies result in limited findings. Perhaps this is why there is not enough evidence to either support or refute the effectiveness of back belts in reducing injuries. Many of the earlier studies that were conducted did not evaluate the most common type of industrial back belts that are widely used today in production areas. If employers (and workers) are currently relying on back belts as personal protective equipment to prevent back injuries, they should be aware that there is a lack of scientific evidence supporting their use.

Rather than relying solely on back belts, the team recommends that employers and workers minimize their risk of back injury by developing and implementing a comprehensive ergonomic and safety training program. A program of this nature would focus on prevention and include:

- 1. Assessment of all work activities to ensure that task can be accomplished without exceeding the physical capabilities of the worker.**
- 2. Incorporate on-going, comprehensive employee training on proper lifting mechanics and techniques.**
- 3. Provide a surveillance program to identify potential work-related musculoskeletal problems.**
- 4. Include a medical management program.**

## B. Cable Puller (Equipment)

Although the team had many ideas about how to reduce lower back injuries, cable pulling was still a major concern. Large T-400 cable was still being pulled in the traditional way by numerous cable crew electricians, rotating positions on different sections of the cable, often straining, pushing and pulling in the process. This method is considered ancient in comparison to most modern methods of cable installation. In shipbuilding, however this method is standard for main cable installation in the construction of large seagoing vessels and universal in most shipyards. T-400 cable, with the exception of the stainless steel braided cable, poses the most concern in cable installation, mainly because of its size and weight.

The danger with stainless steel braided cable is that when the steel braid around the cable is torn or ripped, the thin, exposed fibers cause hand injuries, such as punctures and open wounds.

"There has got to be a better way", was frequently expressed during weekly team meetings. Fortunately, there were other resources available to help team members find better solutions. One of the benefits of recently improved shipyard communication is that information is often shared among various trades throughout the shipyard. A department in one organization may be able to provide a solution to a persistent problem existing within another organization.

During a technology exchange trip to Bath Iron Works in Bath, Maine, Fred Hogan, NSRP Project Engineer and advisor for "EDIPAT", spoke with Karl Siegfried, BIW's company ergonomist about cable pulling. Karl explained that, some years ago, Electric Boat Company had been working on a cable pulling equipment, but had to discontinue the project. Upon further investigation, Fred found that Electric Boat Company previously had been working on such a project. Fred then spoke with the SP-5 Panel Chairman, Chuck Rupy, about this conversation with Karl Siegfried about the cable pulling equipment project. He referred Fred to Greenlee Textron Corp. in Illinois. Fred contacted this company, then met with Greenlee's area representative, Steve Norris.

Fred met with Steve during one of his trips to NASSCO and discovered that Greenlee Textron Corporation did manufacture cable-pulling machinery. The Company was mainly in the business of selling equipment to the utility industry and was not directly involved with any shipyards. He toured NASSCO facility and spoke with Gale Withrow, Electrical PIT Team Leader, about the type of equipment that could possibly be used to pull T-400 cable. He stated that his company had a new type of cable puller on the market that could pull up to 8,000 lbs., **(Figure 7.pages 101-102)** and thought that this machine would be applicable for use on board ships.

He referred Fred and Gale to a local distributor that already had one of these machines in stock. Fred contacted the distributor and one of their sale representatives offered to bring the machine into the shipyard for a demonstration.

Following a successful demonstration by the vendor, NASSCO purchased one of the machines with other optional parts to assist with the pulling process. The potential of this machine, in terms of use and capability, prompted the electrical department to reevaluate and examine the cable pulling process again. The department discovered that T-400 cable could be pulled with ease and that the new machine could pull two lengths of cable simultaneously, thereby eliminating four electricians (stationed on the deck) from the cable pulling process on straight cable runs. Other important features of this machine include durability and mobility. Cable can be pulled from many different angles; upward and downward pulling requires only slight adjustments and optional parts to complete separate processes.

1. The Versi-Boom Plus System can reach into a manhole, yet allow the operator to run the puller from above.
2. The Versi-Boom System gives you the ability to pull out up to 20' of extra cable.
3. The slip-in coupling slips into the conduit or over the conduit. There are sizes ranging from 2-1/2" to 5". Also available are screw-on couplings in sizes ranging from 2-1/2" to 4" for pulling overhead.
4. Capstan is made of steel, which gives the capstan longer life.
5. The lifting eye is for use in moving the unit easily at the construction site.
6. Modular mounting with quick pins. The two-pin system locks the puller in place quickly and easily. Using the pins the boom can be locked into numerous positions, creating different pulling angles.
7. Permanent magnet motor (20 amp @120 volts.) This motor can operate on the job site at lower voltages.
8. Direct gear drive. The Ultra Tugger only weights 86 lbs. It's smaller, lighter and more compact.
9. Right angle sheave allows the operator to stand to the side of the puller and out of the line of tension when pulling.

This machine is versatile with the ability to pull up to 8,000 lbs. utilizing fewer splices to pull longer distances. The machine can be set up quickly, utilizing pins and attachments to mount the puller to conduit, concrete floors or mobile boom to meet all pulling needs.

It should be noted that this machine requires some modifications for shipboard use. Additional welding along with necessary design changes to the base and motor to increase durability is required for marine processes.

## RECOMMENDATIONS

During the past year, a number of PIT teams, representing Steel, Electrical, and Blast & Paint trades, has made several recommendations for improving safety with a strong emphasis on injury prevention. These recommendations were the natural outcome of various findings, along with the successful intervention, development, and implementation of an effective prevention program. Team members also discovered that a "proactive approach" to injury prevention seems to work best. Rising injury statistics and increased injury, rates have been costly to many companies in terms of lost time and money. This has sparked the need for special programs in which participants are not only tasked to study causes, but to determine the types of behavior that "drive" these statistics. During the process of analyzing causes, PIT team members discovered that many of these "statistics" could have been significantly reduced or eliminated by changing "antecedent" behavior.

Although the various teams were successful in their efforts to reduce injuries, cut costs, and improve the quality of life for their fellow workers and supervisors, an extensive amount of time and effort were required to finalize the conclusions of this report. The process of researching and gathering information included many activities: interacting with a number of vendors, physicians, and safety professionals; spending several hours at a number of work sites; interviewing and interacting with numerous trade representatives, in order to acquire accurate information about specific trades, and to gain adequate knowledge and understanding of different trade processes. Most of the team met once a week, beginning in March of 1997. (The Blast & Paint Process Improvement Team began meeting six months earlier in September of 1996). An average meeting was scheduled for approximately one to two hours, but actual times relegated to field activities and research averaged about three to five hours per week.

This report is not intended to serve as a guide, but rather as a model - with recommended practices and procedures. Other considerations, with respect to company interests are also important, such as financial investment. Financial resources along with dedicated and committed personnel can help to achieve quantifiable results. While resources are necessary to implement the recommended procedures and practices, "commitment" (from the head of the organization to the lowest worker on the deck plates) is essential to the success of any program. A sense of enthusiasm, generated from upper management, is needed to capture and maintain the interest of all employees.

Certain company issues must also be resolved in order for a program to be successful. One issue that continues to be of concern among PIT team members

is "Production versus Safety". Production decisions should not override safety concerns. Production versus Safety should not be an issue of priority. A healthy, safe employee will increase production outputs. There may be some exceptions, but team members found that most employees are just as conscientious about production as they are about safety. As team members have often stated, "we believe that each employee has the right to return home (from the workplace) to family and loved ones injury free".

The modern industrial workplace is considered much safer today than during the early 1900's, as the quality of life has greatly improved in today's industrial work environment. However, the safety and welfare of company employees, whether in a manufacturing operation or otherwise, should not be compromised for production.

**The following are practices and procedures recommended by the different teams to reduce worker's compensation costs:**

**A. Pre-Employment Testing**

Applicant Screening should include more thorough pre-employment physical testing for overall fitness. In accordance with the American Disability Act, the following requirements should be met:

1. An offer of employment should be conditioned on passing a post-offer physical examination.
2. The examination should test for essential job related abilities only.
3. The examination should be required of all persons conditionally offered employment for the particular job or position.

In addition to the "essential functions" component necessary to make hiring recommendations in accordance with ADA, a comprehensive battery of additional medical and functional performance tests should be performed on each employee to establish baseline capabilities. This also facilitates detection of existing impairments and other medical and physical conditions. (Note: This medical and functional data cannot be used to withdraw an offer of employment tendered an employee.)

Following completion of the test, results would then be entered into a pre-employment test database, thereby providing a profile on each individual employee according to the physical demand levels of each specific job. The reports generated would also establish the baseline medical and functional

capabilities of the employee for comparison to future, post-injury data. During the pre-screening process, compare applicant's backgrounds to work applied for and look for best match or fit. Evaluate the applicant's skills and experience. Implement "behavioral based" interviewing to tie questions to previous experience. Both production and human resources should be present during formal interviews.

Once applicants are hired, only those who are physically able to perform continuous heavy lifting should be assigned to pull heavy cable on a routine or continuous basis. Specifically, this is to avoid placing or assigning new hires as well as long term employees, who are not able or capable, to areas where performing continuous heavy lifting is a requirement.

**The following are various types of pre-employment testing used in manufacturing industries permissible during pre-offer of employment screening (Emphasis on production in Shipbuilding).**

- a. General aptitude assessment or "Scored Tests" include literacy and mechanical reasoning testing.
- b. Work samples - skills testing (basic and advanced levels) are trade specific. Widely used, job samples are probably the most valid and efficient personnel selection tool.
- c. Psychological profile (this type of testing can take various forms). Personality testing generally involves analyzing applicant responses from which HR personnel can determine job related personality traits and characteristics that are most likely to surface in the workplace.
- d. Integrity testing (where behavioral indicators are derived from applicant responses), is used to determine an applicant's overall tendency to engage in counter-productive behavior.
- e. Formal interview

**Upon conditional, offer of employment:**

- a. Drug screening - A requirement for companies representing industries with government contracts. In addition, where serious safety risks exist.

- b. Physical testing - usually a comprehensive "physical" but often includes physical abilities tests.

## **B. Training and Fitness**

### **1. Training**

There is a need for more specialized training in injury prevention for leadmen, working foreman and production supervisors. Increased training and safety awareness must start at the supervisory level. Production supervision must enforce the message of safety and injury prevention in the work environment. Subjects that can be reviewed include:

- A. Training films on accident prevention as required viewing.**
- B. "Effective communication" classes for leaders (possible certificate series). Purpose: To help supervisors develop effective communication skills, to ensure communication of the message "safety first".**
- C. How to manage behavioral change. Appropriate action supervisors should take to get the desired responses they expect.**
- D. Using employee advisors appropriately in getting employees to change their behavior.**
- E. How to approach an employee from another trade when there is a safety issue. How to break down barriers.**
- F. Testing of supervisors and employees after the conclusion of safety classes to see if they really understood the information.**
- G. Emphasis on safety vs. scheduling. Often appears that problems are overlooked when scheduling is priority over safety.**
- H. How to get the whole crew motivated and encouraged about safety.**
- I. How to detect employee fatigue, possible drug or alcohol**

**problem and how to take appropriate action.**

**J. How to inspect articles of clothing, portable tools, work area, for unsafe conditions.**

**C. Stretching / Exercise (During and After Work)**

When employees arrive for work in the morning (or evening), they likely have just started their daily routine a few hours before and therefore haven't really "warmed up" prior to work activities. It is important for employees, who are about to perform heavy, labor intensive work activities, to engage in some pre-work stretching exercises. This can decrease the potential for injuries, especially lower back injuries. Employees need to be properly trained to perform stretching exercises correctly, and to know that when they are warmed up, they are more prepared to perform strenuous activities, such as pulling heavy cable. For cable crew employees, it may even reduce the stress associated with having to perform their tasks in physically contorted positions while working in confined spaces on board.

For employees who want to increase their resistance to disabling injuries, post work stretching and exercise can be beneficial. Professional athletes train and condition their bodies to withstand a tremendous amount of tension and stress. This type of conditioning can also be beneficial to employees who routinely engage in labor intensive work related physical activities. Employees cannot be forced to engage in post work exercises, but can be encouraged to make the effort to do so.

Many companies in the United States are emphasizing the value of exercise and fitness. Many have highly structured wellness programs that include diet, exercise, smoking cessation, and daycare programs to accommodate single and married employees. The availability of such programs has

contributed to increasing employee morale as well as reducing injury costs to companies. When surveyed, the Electrical Department employees at NASSCO all said that they would participate in an after work exercise program if one was available. It was surprising to team members that most of these employees believed they would feel "energetic" and actually want to exercise after an eight hour work day of pulling and lifting heavy cable.

#### **D. Job Rotation**

Supervisors should be encouraged to rotate employees pulling large, heavy T-400 cable periodically. Frequent rotation of employees to other assigned work areas is highly recommended, especially since this task involves a routine of continuous heavy lifting. Crew members can be rotated frequently (hourly, daily, weekly) or from time to time (monthly) so that no employee is continually pulling the larger/heavier cable.

**The following is a suggested format for rotating cable crew employees pulling T-300 or larger cable:**

##### **A. Large cable installation (Daily)**

- 1. Rotate workers on the "feed" every two hours because of exertion necessary to lift cable into overhead wireways.**
- 2. Rotate individuals working in the wireways or at the end of cable pullout every four hours.**
- 3. Remind crew members that if any worker is feeling fatigued, inform the supervisor. It may be necessary to assign the individual a different task.**

## **E. Back Belts**

Information from various studies (and companies) concerning the use of back belts, for the most part, are inconclusive. The team recommends the use of back belts as a secondary precaution against lower back injuries. Redesigning the work place and making it easier for employees to perform their assignments, however, should be a main priority. Many companies do not believe that training is worthwhile, but, before coming to that conclusion, they need to consider what types of training programs could be beneficial to their employees. Employees participating in a back belt program need to understand that back belts are not a "cure-all" for back problems, but can serve as an additional prevention measure-reminding them to lift safely.

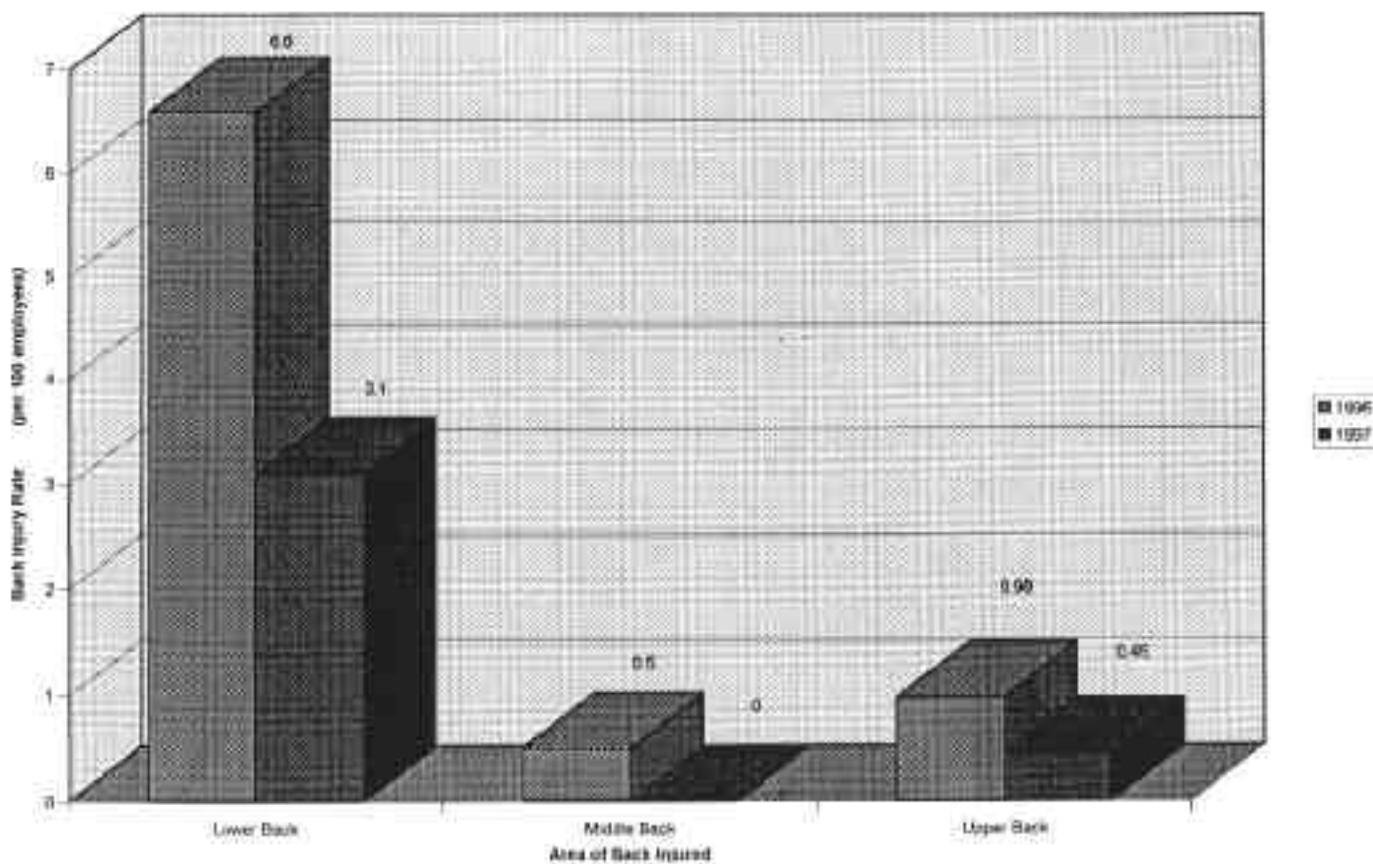
For a mandatory back belt program to be successful will depend on the type of back belts a company chooses to purchase for its employees. The air type back belts were well received by the electrical cable crew employees at NASSCO. They explained that these belts seemed to work well for them in terms of wear, protection, style, comfort and personal choice.

Although it was not mandatory for all cable crew employees to wear these belts, they were available to employees who wanted to use them. This seemed to be a positive approach. It is important to remember that, when selecting back belts, or any other type of personal protective equipment, "employee buy-in" is very important. It is important for the successful implementation of any injury prevention program.

## APPENDIX

Figure 1.

1996 & 1997 Electrical Department Back Injuries



3/96 - 12/96

3/97 - 11/97

Figure 1.

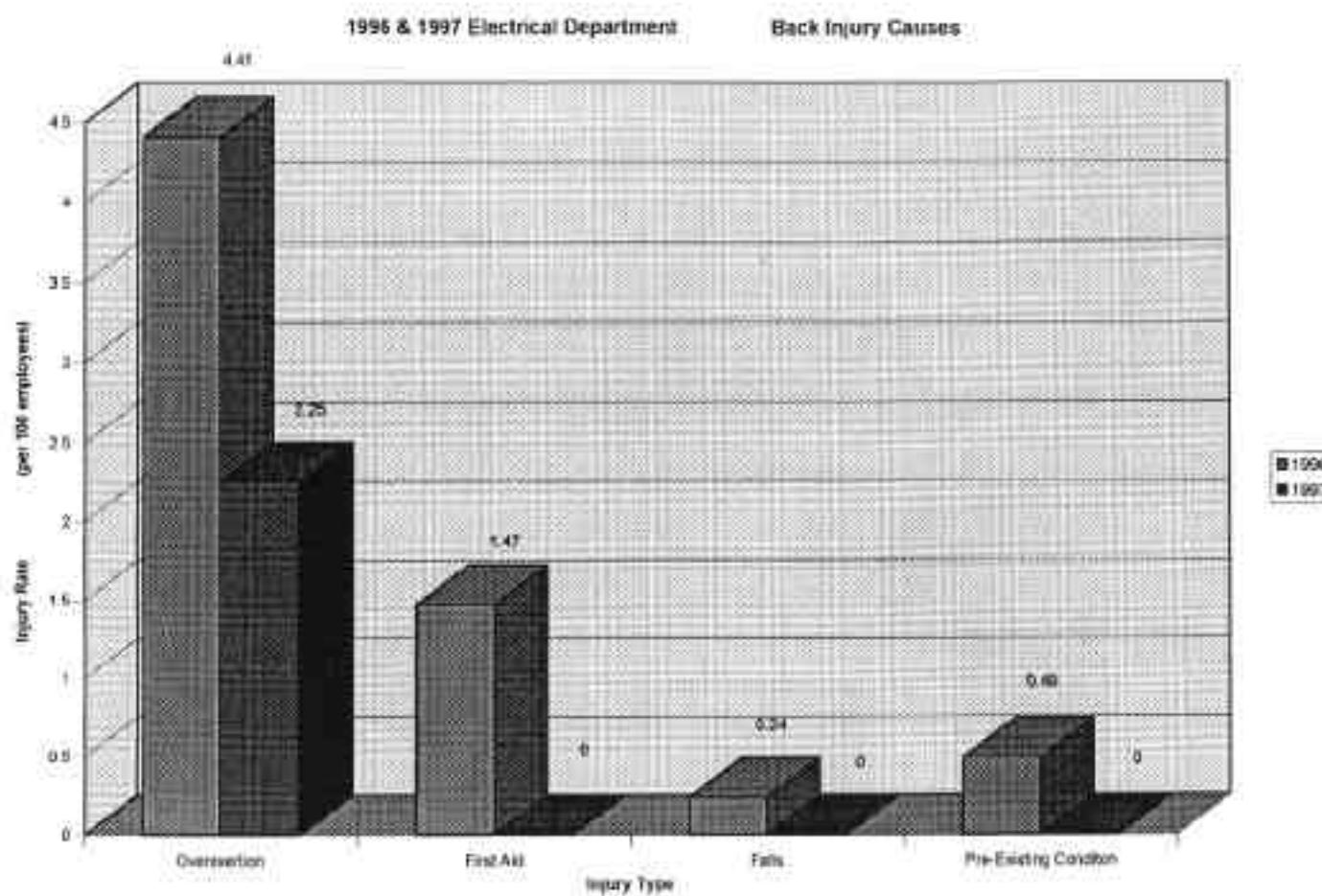


Figure 1.

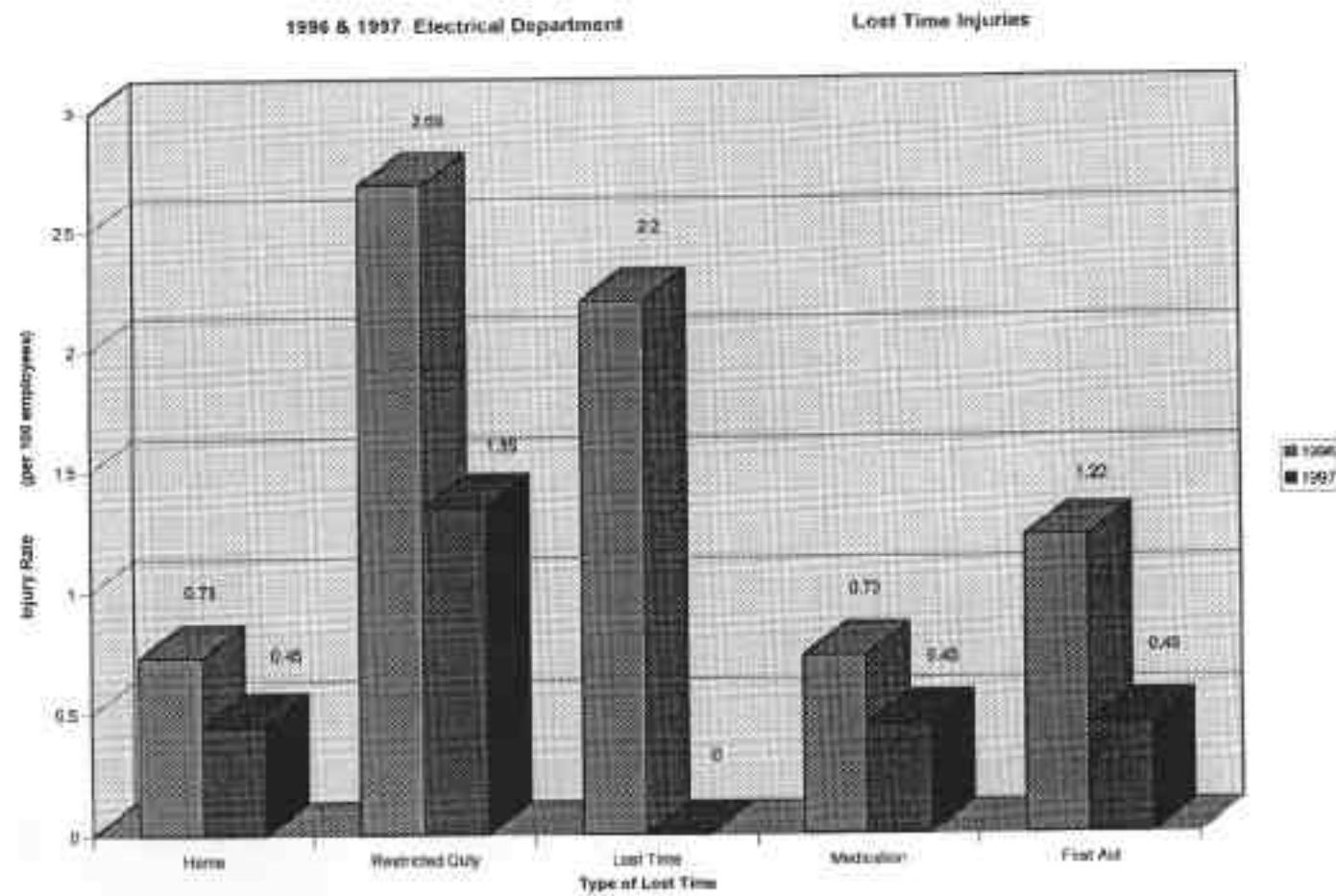
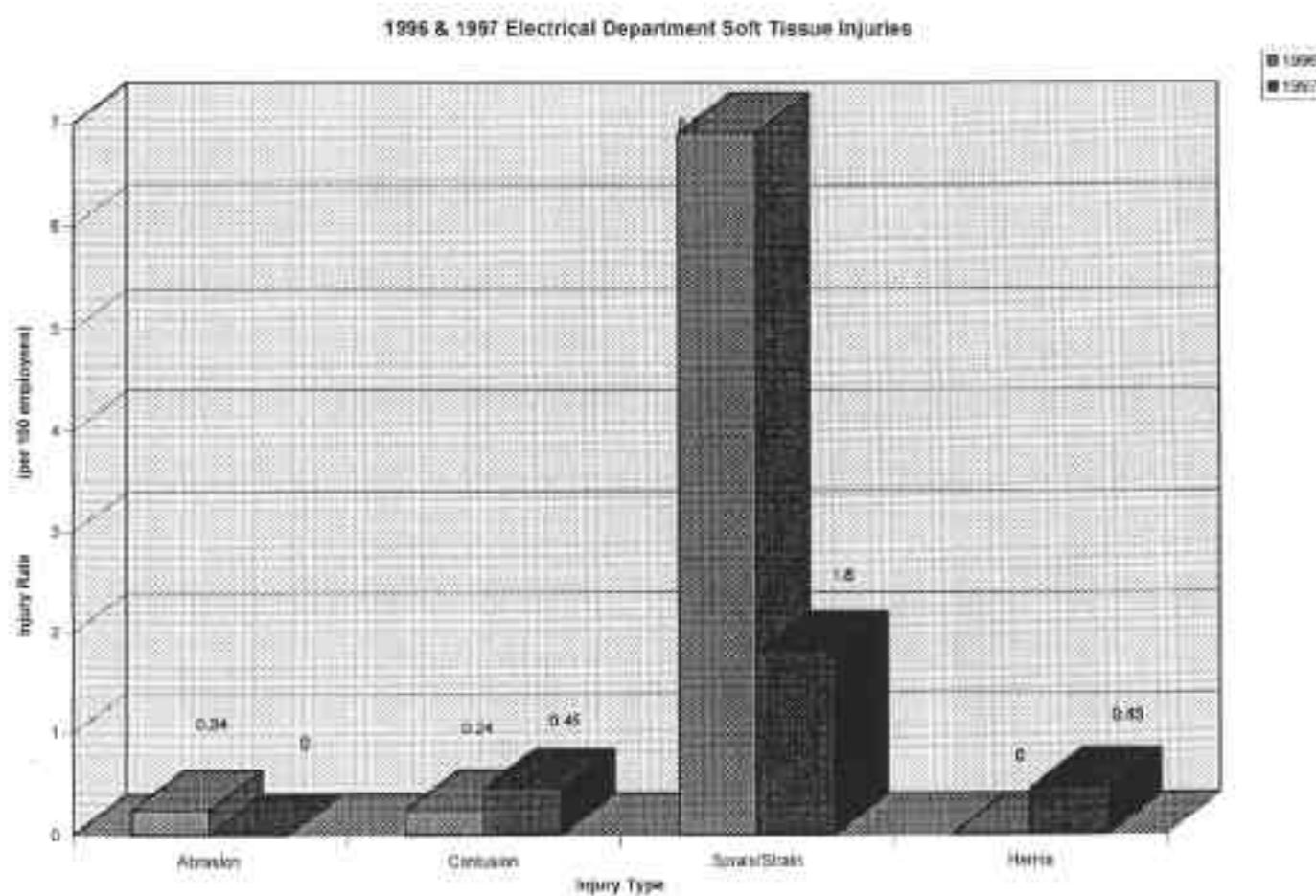


Figure 1



**Figure 2**  
**Survey Questionnaire Responses**

Question #2

How Do You Know When You're Involved in a Potentially Dangerous Situation or Work Task?

1. Looks at Surroundings
2. Extra Careful
3. Gut Feeling
4. Nature of Job, Location, and Experiences
5. Experience
6. "You Don't Feel Right About It"
7. Cluttered Area with Lines and Leads
8. ?? (Says She's Never Been in One)
9. (No show)
10. Common Sense
11. Sight, Sound
12. Common Sense
13. Gut Feeling
14. Common Sense
15. Experience
16. Gut Feeling
17. Type of Job
18. Surroundings

Answer Breakdown:

Common Sense: 3  
Experiences - 3  
Gut Feeling - 4  
Job - 2, Surroundings - 3  
No Answer - 2, Other 2

## Survey Questionnaire Response

### Question #13:

What Three Things Can Electrical Dept. Employees Do To Reduce Back, Muscle, and Tendon Injuries?

1. Stretching
2. Back Braces
3. Warm Up
4. Exercise
5. Continuous Training (Safety)
6. Housekeeping
7. Breaks (water)
8. Proper Rest
9. Rotate Job Assignments
10. Attention to Surroundings
11. Follow Rules
12. Proper Lifting Techniques
13. Proper Use of Equipment
14. Better use of Existing Equipment
15. Know Personal Limitations
16. Change Positions Occasionally
17. Play Smart
18. Protect Self
19. Recognize Hazards
20. Teamwork
21. Better Informed
22. Weight Belts
23. Limber Up
24. Prepared to do the Job
25. Be "In Control" When Working
26. Shorter Ladders Available on Board
27. Need to be in and Stay "In Condition"
28. Avoid Getting into too Much of a Hurry
29. Listen to Your "Gut Feeling" about/in a situation
30. Do Away with rolling Scaffolds
31. Only "Physically Fit" Should Perform Continuous Heavy Lifting
32. Employees "Hand Picked for Pulling Heavy Cable
33. Employees should Take Their Time
34. Think of an easier way to do the Job

## Survey Questionnaire Responses

### Question #14:

How Does Personal Responsibility Play a Role in Preventing Injuries?

1. Knowing Limitations
2. Prevents Injuries
3. "A Mental thing"
4. Fear of Losing Job
5. By communicating
6. Things of family
7. "Will Better control Your Actions"
8. More Conscientious and Aware
9. (No show)
10. In Decision Making
11. Have to be Vigilant
12. To Set an Example
13. "Helps you Know when Something is Wrong"
14. "For Myself, For My Injuries, Not for Others (Injuries)"
15. "A Big Role"
16. Personal Awareness
17. (Same as above)
18. Helps to Keep Everyone Productive and Safe

Figure 3

**THERAPY**

**SPECIALISTS**

PHYSICAL OCCUPATIONAL SPEECH HAND

**BACK INJURY PREVENTION**

Back injuries are among the most common and most expensive to the employer. 80% of the population has or has had difficulty with their back. 60% of these individuals will have recurrent back injuries to some degree. It is important that we know as much about our backs and how to safely take care of them.

The concepts that are important to understand are the following:

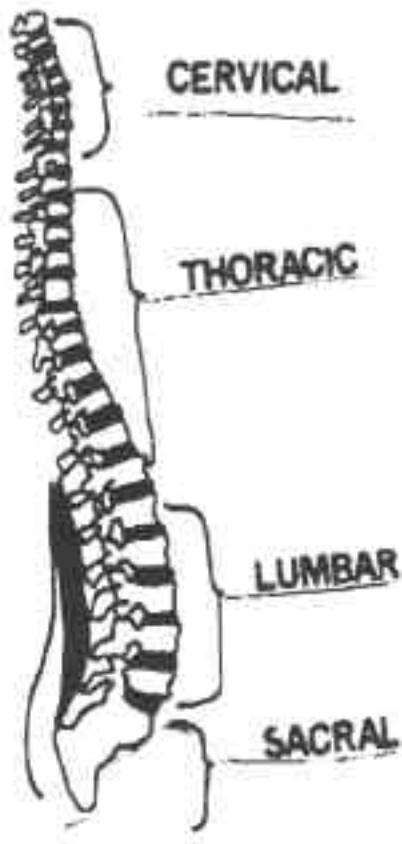
1. The anatomy of your back and how it functions best
2. Neutral Back
3. Hinging
4. Bracing
5. Conditioning and Healthy Behaviors
6. Symptom management Strategies

It is important that you apply the above principals to your daily life.

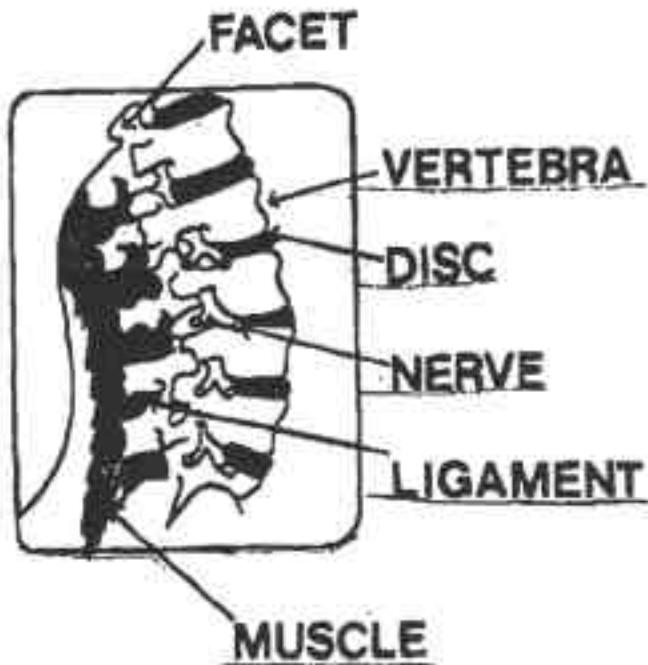
### HOW YOUR SPINE IS BUILT

In order to know the difference between correct posture and incorrect posture, we must first have a good understanding of how the spine is arranged.

The spine is made up of 26 small bones, called vertebrae, stacked on top of each other. The main functions of the vertebrae are to protect the spinal cord, provide a fulcrum for movement, and serve as a point of attachment of muscles that hold the body upright. Vertebrae are classified into five groups by their shape and function. The areas most affected by posture are the cervical area, or neck; the thoracic area, where the ribs connect; and the low back or lumbar area. While the sacrum is one solid bone, the connection between the sacrum and the lumbar area is a common area of pain if the angle is larger than it should be. This angle is very important when considering the mechanics of good posture. The concepts of NEUTRAL SPINE, BRACING, HINGING, WEIGHT SHIFTS, BASE OF SUPPORT AND CENTER OF GRAVITY, will be discussed later.



Between the vertebrae are fibrous "cushions" called intervertebral discs. These act as shock absorbers to protect the vertebrae and brain and allow motion between the vertebrae. It is this motion which allows you to bend over or look over your shoulder. The facet joints, which are formed by the overlapping of two vertebrae, are responsible for guiding this motion of your spine. Spinal nerves exit the spinal column between the vertebrae near the disc and facet joints. These nerves control all functions of the body and vital organs including movement and sensation. Last, but not least to be considered, are the muscles and ligaments which support the spine and hold it in an upright position. The most important of these are the stomach muscles which should be strong and in good condition, not weak and saggy.



Your leg and back muscles when strong help to support the back as well. When you are able to maintain your back in neutral, brace with your abdominals, hinge and wt. shift you can use your center of gravity to your benefit. The forces on your low back are significantly decreased and your muscles and ligaments have the advantage. It is important that you understand these concepts. Below are definitions of these important concepts.

**NEUTRAL SPINE:** The position in which the three natural curves of the spine are in their most balanced, safe and efficient alignment. Since an excessive arch (away back "sagger") and a decreased arch (flat back "sloucher") can cause low back pain, that is why it is important to prevent both extremes and maintain your spine in a neutral position.

**BRACING:** Voluntary abdominal (stomach) contraction to maintain your spine in neutral and protect your low back. This technique stabilizes the spine during loaded or weight bearing activities. REMEMBER: bracing is not a sucking in of your stomach muscle. Imagine that you have a wt. lifting belt across your stomach, you tighten (push your stomach muscle out) into the belt. Do not arch your back. We tighten these muscles naturally when we laugh .

**HINGING/AXIS OF MOTION:** The joint or joints at which movement is occurring. The goal is to shift the axis of motion from the spine to other joints. The hips, knees, and ankles have their own naturally occurring hinges. When the proper hinges are utilized the muscles and ligaments are working most effectively.

**WEIGHT SHIFT:** Transfer of weight from one stable point to another. All movement is initiated with a weight shift.

**BASE OF SUPPORT AND CENTER OF GRAVITY:**

Greater stability is obtained by :

- 1) lowering your center of gravity
- 2) widening the base of support in the direction of the line of force
- 3) keeping external forces or objects nearer to the center of gravity

While the short and long term effects of poor posture are many, those that cause most concern are the ones which cause pain in the low back. To summarize poor posture causes the following effects on your low back:

- 1) Increased risk of pressure on the nerves due to degeneration of spinal structures.
- 2) Poor mechanical leverage for the muscles and structures when lifting or doing heavy work.



- 3) Strain on the muscles and ligaments of your back and neck, leading to rapid fatigue and discomfort.
- 4) An abnormal curve in your low back leads to an abnormal curve in your neck, and vice versa, because the curves of your spine try to balance and compensate for each other.

#### PROPER BODY ALIGNMENT



Center your head over your shoulders, slightly tuck your chin.

Balance your shoulders over your pelvis. Your shoulders should not be rounded or arched.

Your pelvis should be level and your abdominal muscles braced. This will decrease the arch in your back.

Keep your knees straight but not locked.

Spread your feet a few inches apart so they are aligned with your hips. This gives you a wide base of support and greater stability. Distribute your weight evenly between your heels and toes.



## CONDITIONING AND HEALTHY BEHAVIORS

Most back pain is the summation of many small aggravations to your back. Each of these aggravations may be insignificant; but when they are added together, cause irritation and inflammation which eventually results in spinal degeneration. This chronic irritation caused by these repeated aggravations makes it easier to injure your back, and episodes of back pain become more frequent.

If you maintain your spine in correct alignment, keep the muscles surrounding it strong and flexible, exercise on a daily basis, and sleep and eat well you will decrease the risk to your back. It is important that you are the proper weight for your height. Excess weight decreases abdominal support for your low back and puts additional strain on your vertebrae. Good nutrition is necessary for achieving and maintaining good physical condition. Keep junk food and alcohol to a minimum. A good night's sleep prevents fatigue, thus decreasing the chances of re-injury. When choosing sports or activities, consider good exercise principles and avoid abrupt movements.

Your physical condition has a large influence on how you feel. Being in "good shape" makes activities easier, thereby enabling you to do your daily routine with energy to spare. Your tolerance to pain is also increased and it is a healthy outlet for relieving stress. With increased exercise your heart becomes more efficient and circulation and nutrition to your tissues improves. The quality of your sleep improves as well. Make sure that the exercise activity that you choose can be done regularly and frequently. Remember to maintain good spinal alignment during your activity.

Recommended activities include:

WALKING

HIKING

BIKING

SWIMMING



## SO WHAT DO I EAT?

In order to get all the nutrients your body needs, five food groups should be included in your daily diet.



### Milk Group

2 servings a day for adults, 3 for children and 4 for teenagers. Provides protein, calcium, phosphorous, and several vitamins. This group includes milk and milk products such as cheese and yogurt.



### Meat Group

2-3 servings per day. Provides protein, iron, zinc, vitamins B<sub>6</sub> and B<sub>12</sub>. Foods included in this group are meat, fish, poultry, eggs, legumes, and nuts.



### Vegetables and Fruits

4 servings per day. Provides vitamins, minerals and fiber. Include a variety from this group in your daily diet.



### Breads and Cereals

4 servings per day. Provides B vitamins, iron, fiber, and minerals. Products made from whole grain or enriched flour, rice, and cornmeal are included in this group.



This group provides mostly calories, so there is no recommended number of servings per day. Amounts eaten should be guided by calorie needs. If you're overweight, you'll want to avoid these foods as they are high in calories. If you're underweight, they are a good source of extra calories, but don't use foods from this group in place of the other four groups because they are low in nutrients. Butter, margarine, oil, salad dressing, fried snack foods, cake, cookies, candies, and numerous other items are included in this group.

## **THERAPY**

### **SPECIALISTS**

PHYSICAL OCCUPATIONAL SPEECH HAND

THESE BACK CONCEPTS CAN BE TAUGHT AND UTILIZED FOR ANY TYPE OF JOB. THE BETTER THE UNDERSTANDING THE SAFER THE WORK ENVIRONMENT WILL BECOME. THERE WILL BE LESS INCIDENCE OF BACK PAIN NOTED.

FOR SPECIFIC INSTRUCTIONS ON HOW TO APPLY THESE CONCEPTS IN A PARTICULAR AREA AND TO GAIN SPECIFIC KNOWLDEGE OF THE GENERAL CONCEPTS, PLEASE CALL THERAPY SPECIALISTS AT 2818-4900. JEANETTE BARRACK P.T.

## Education on Your Air Belt\* Back Support

### The AIR BELT ... Principles of Operation

#### Pictures not available

It is a uniquely designed inflatable lumbar support, which can be conveniently worn inside or outside of clothing without restricting mobility. The Air Belt lumbar support acts to reduce the risk of muscular lower back discomfort. The interconnected chambers conform to your back when air is added. As the chambers fill, they apply forward pressure over the muscles. This pressure promotes muscle relaxation and encourages the proper alignment of the lower back.

### QUESTIONS OFTEN ASKED ABOUT THE USE OF THE AIR BELT

#### *Does the Air Belt weaken muscles?*

By allowing a full range of motion, the Air Belt does not weaken muscles. Individuals will use their muscles in a normal manner.

#### *Does the Air Belt only remind the user to lift properly?*

Lifting properly or working smarter is a function of training. Reminding is a positive reinforcement of training. Safety products do remind but worthwhile products have their own functionality. The Air Belt helps to eliminate unwanted lower back contractions. This will reduce fatigue and residual back pain that will occur if unwanted contractions from work go unchecked. The Air Belt helps maintain proper posture by placing pressure on shortened muscles, allowing them to return to their normal resting length to promote proper spinal alignment. This alignment is often expressed as keeping your head and shoulders over your hips. This alignment should be stressed when lifting, standing or even when you are seated.

#### *Does the Air Belt cause a false sense of security?*

The need for ongoing training and understanding of the product cannot be overstated. You must recognize that back belts do not make you stronger!! It is by providing ongoing training that the wearer will understand this fact. Each individual must recognize their own limitations and act within them. Your employer appre-

ciates your input and suggestion regarding your workplace. Safeguard Technologies will assist in a comprehensive approach to reducing the occurrence of back injury by making available training aides and programs. Each of our back supports has a warning label to remind the wearer of the belts limitations and the need to act in a responsible manner.

#### **IMPORTANT FACTS ABOUT THE AIR BELT**

*Instructions:* Each belt comes with a complete set of operating instructions.

*Sizing:* When determining belt size, add 2" to measurement if belt is being worn over clothing.

*Care of the Air Belt:* Your Air Belt can be scrubbed by hand with a mild detergent in warm water. Air dry. Do not machine wash or place in a dryer.

*Warning:* This is only a support belt and should not be considered a remedy for back problems. If you are under the care of a health care practitioner, consult with them before using your Air Belt. This belt will not guarantee freedom from all back strain. Always utilize good judgment and proper lifting techniques, especially when objects are below 30 inches from the floor. This belt is not to be used as a safety device with a tether line against slipping and falling. Not a flotation device.

Figure 5

## **E.L.A.T.E.**

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**ERGONOMICS. LIFTING. ANATOMY. TRAINING. EDUCATION**

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**How to Reduce Back Injuries on the Job**

**Discussion on what ergonomics is and  
how it affects our bodies**

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**What are the causes of back injuries**

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**The effects of back injuries and  
What it means to you and your company**

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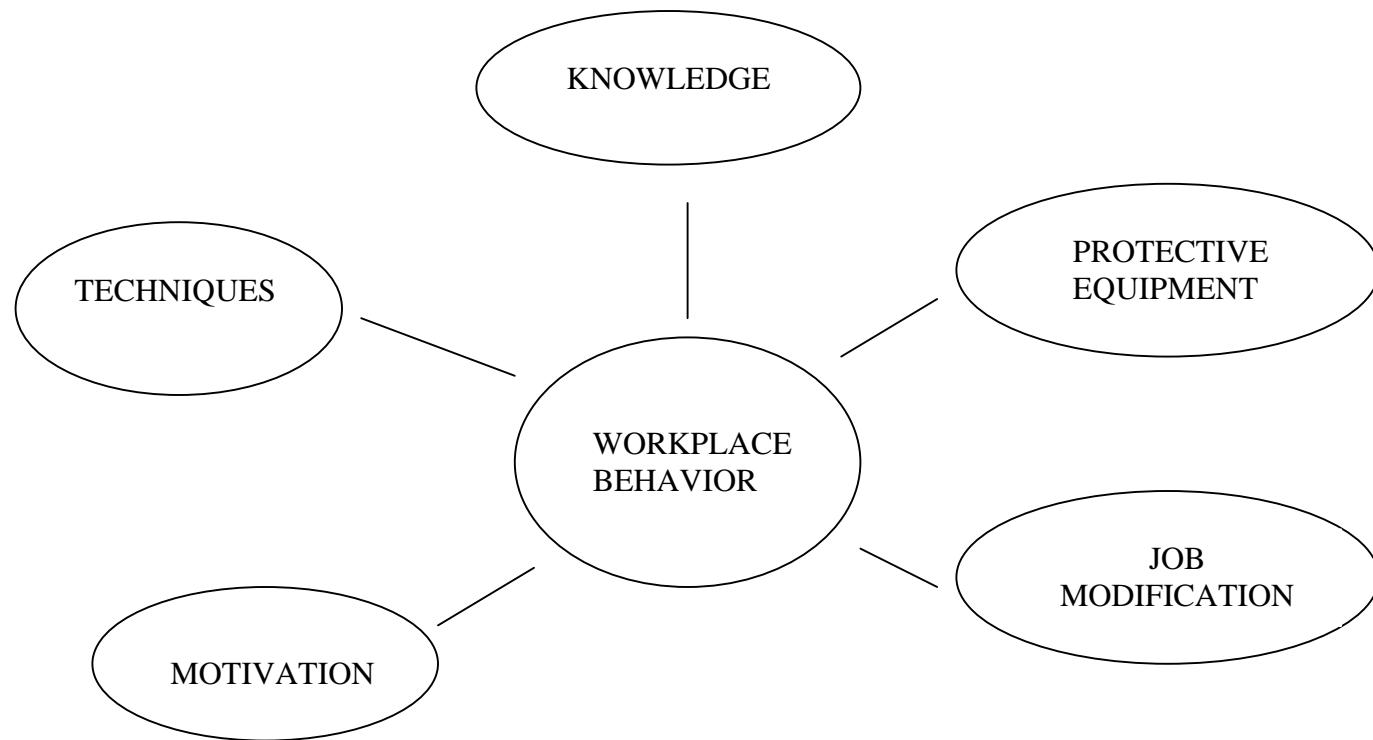
**Training on proper lifting techniques**

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**Complete education on all products  
Including care and proper use**

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## DEVELOPMENT OF GOOD WORK HABITS



## **Sweat Equity**

*How much production in sales dollars does your company spend to pay for back injuries?*

- National Safety Council says the direct cost of a back injury ranges from \$11,000 to \$17,000.
- The next slide shows a chart which was prepared using data provided by Citibank of New York. It states in sales dollars how much a company in various classifications surrenders to pay for an average back injury, using \$11,000 as the cost basis.
- Multiply the sales amount by the total number of back injuries to determine the yearly effect on your company.

## Sales Required to Pay For the Direct Cost of a Back Injury

Aerospace	234,035	Department, Specialty Stores	340,355
Air Transport	647,065	Distilling	180,335
Amusements	90,905	Drugs, Medicine	103,776
Autos, Trucks	423,080	Electrical Equipment, Electronics	211,530
Automotive Parts	244,440	Electric Power, Gas	123,590
Baking	305,560	Farm, Constructn, Mat'l Handling Eq.	189,660
Brewing	41,910	Food Chains	846,164
Building, Htg, Plumbing Eq.	177,430	Food Products	289,475
Cement	106,790	Furniture, Fixtures	349,750
Chemical Products	177,450	Glass Products	215,690
Clothing, Apparel	220,000	Hardware, Tools	207,540
Common Carrier Trucking	314,295	Household Appliances	265,290
Construction	398,840	Instruments, Photo Goods	127,900
Dairy Products	323,530		

## Sales Required to Pay for the Direct cost of a Back Injury

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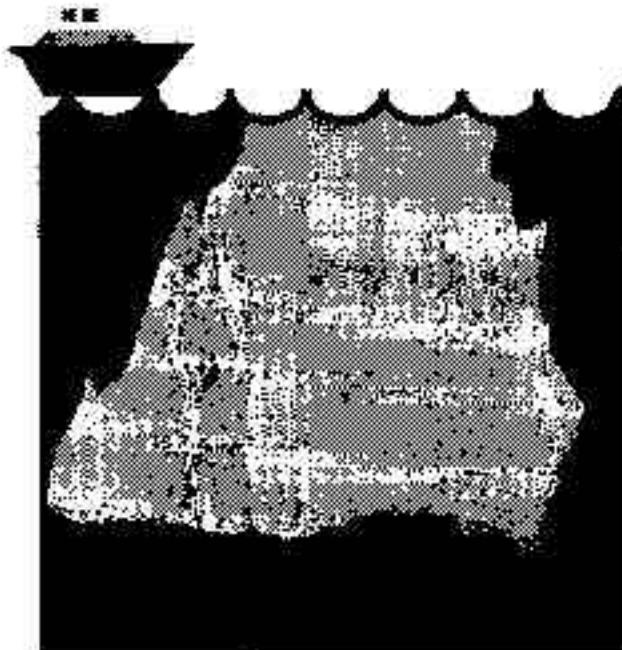
Iron, steel	323,575	Railroads	314,295
Lumber, Wood Products	141,020	Restaurants, Hotels	180,335
Machinery	186,450	Rubber, Allied Products	578,950
Meatpacking	1,000,010	Shoes, Leather Goods	323,535
Metal Mining	55,835	Soap, Cosmetics	180,335
Metal Products	260,910	Soft Drinks	174,815
Nonferrous metals	152,770	Stone, Clay Products	203,700
Office Equipment, Computers	99,110	Sugar	229,165
Paint, Allied Products	407,420	Telephone and Communications	94,820
Paper, Allied Products	166,715	Textile Products	343,750
Petroleum Products, refining	177,870	Tobacco products	183,325
Printing, Publishing	157,145	Variety Store chains	458,325
Quarrying, Mining	164,625	Wholesale Houses	450,200

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# Hidden Cost of Accidents

## Direct:

- Medical



## Indirect:

- Economic loss to injured family
- Lost efficiency due to breakup of crew
- Lost time for extra supervision
- Cost of training replacement
- Spoiled work
- Less production
- Failure to fill orders

## Contributors to Back Injury

- Lifting, twisting, bending incorrectly
- Poor posture
- Fatigue
- Accidents
- Sports related injuries
- Diet
- Genetic predisposition
- Stress
- Heel strike

The above noted situations generally are contradictory to maintaining the natural "S" curve of the back.

Ergonomics:  
The function of designing and  
adjusting the workplace to the worker  
to achieve safety, injury avoidance,  
health, productivity and  
improved morale.

## Ergonomic Evaluation

- Worksite – equipment/layout
- Work practices – how tasks are done, frequency, bulk, weight, duration
- Employee capabilities – may require medical input
- Define change – and cost
- Prioritize action
- Measure results

# Understanding Your Back

Your spinal column consists of 24 bony vertebrae which are stacked one upon another; they are separated by discs which act as shock absorbers.

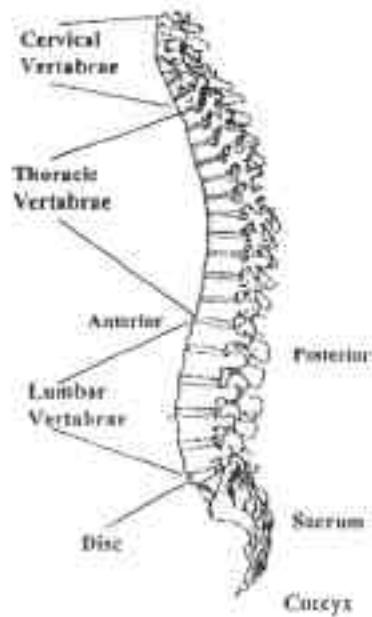
The neck area is called the cervical region, consisting of seven vertebrae, and curves forward.

The mid-back area has twelve vertebrae and is called the thoracic region. This curve is backward.

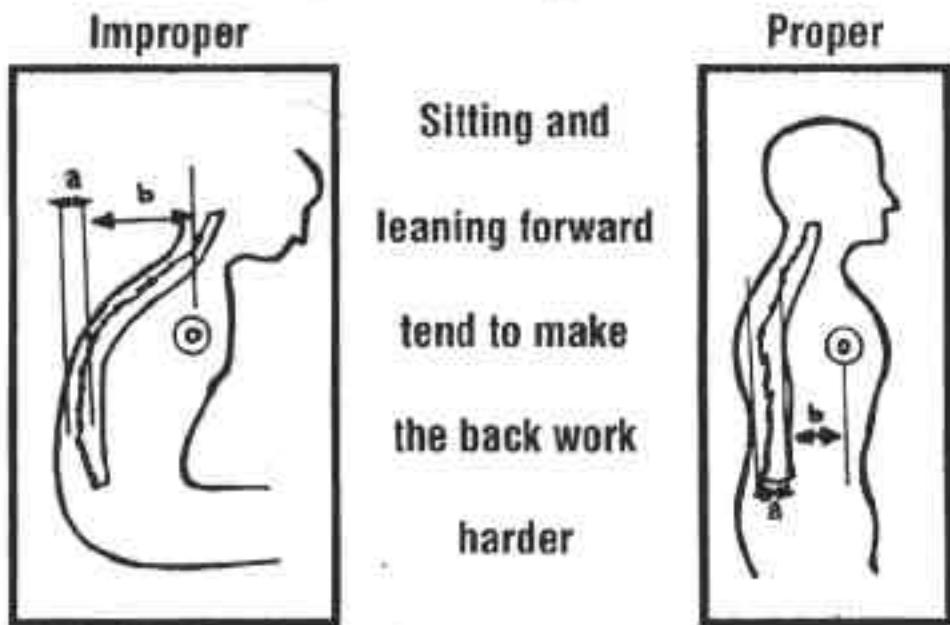
The lower back area is called the lumbar region and is made up of five vertebrae, which curve forward.

Below the lumbar region is a solid mass of bone called the sacrum.

The muscles of the back control the shape of the spine.

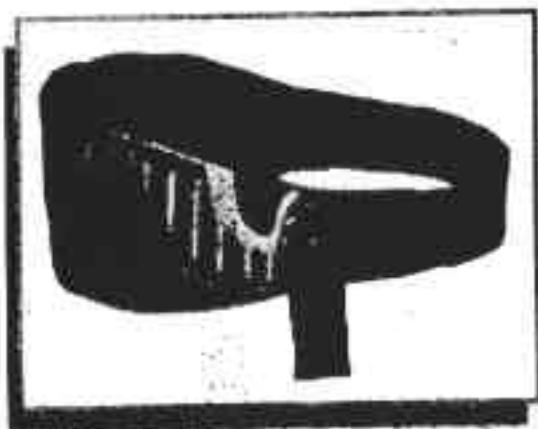


## Spinal Alignment

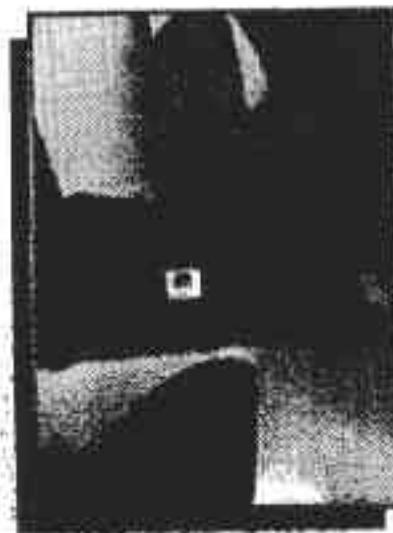


**As dimension "a" increases relative to dimension "b", back muscle activity decreases**

## Air Belt Principles of Operation

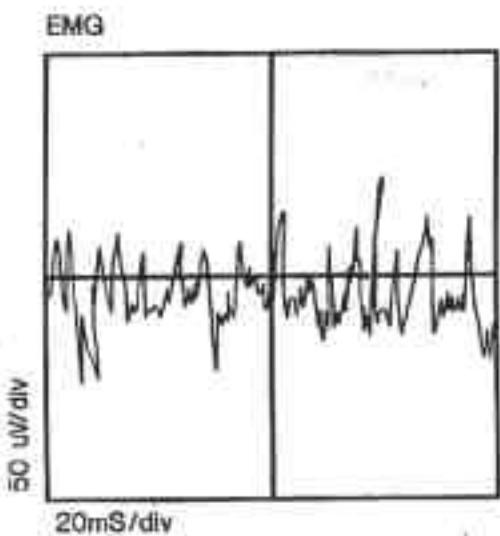


*Interconnected chambers uniquely conform to your back as air is added.*

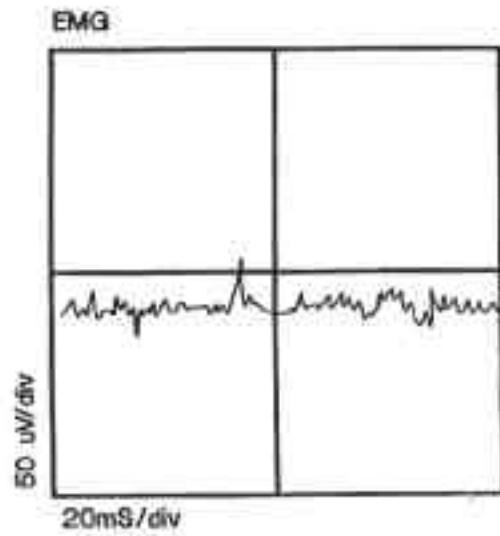


*Creates forward pressure to support muscles of the back.*

## Air Belt Electromyographic Recordings



Without Air Belt



With Air Belt

## **Air Belt Addresses Most Commonly Cited Concerns About Back Belt Usage**

- Air Belts do not weaken muscles
- Air Belts do more than remind the user to lift properly
- For properly trained users, Air Belts should not cause a false sense of security



## 1. Think

Size up your load. Think about the weight and the bulk that you want to handle.

## 2. Ask for help

If you need assistance, request it. When lifting with another individual, make sure you lift and lower together. Choose one person to give the signals.



## 3. Firm footing

Get a firm footing. Keep your feet apart for a stable base and point toes outward. Do not lift when off balance.



## 4. Bend knees

Bend your knees, not your back. Do not bend at the waist. Keep principles of leverage in mind.

## 5. Tighten stomach muscles

Tighten your stomach muscles before lifting. Abdominal muscles support your spine when you lift.



## 7. Safe lifting range

Keep load close. If possible hold both forearms against your body at waist level and your hands near your stomach. At minimum keep your elbows near your sides, with hands moving between shoulders and thighs.



## 6. Legs, arms, back

Lift with legs, arms and back muscles. They can all help do the work of lifting. Don't totally depend on your back muscles.



## 8. Shoulders over hips

Keep back upright and shoulders and hips lined up. Whether lifting or putting down the load, don't add the weight of your body to the load by bending forward.



## 9. Pivot feet to turn

Avoid twisting by pivoting your feet. Move your whole body in the direction of the turn.



## 11. Lower slowly

When lowering your load, remember to have a firm grip on the object. Lower your entire body slowly, bending the knees and keeping the back upright. Do not use a jerky motion or twist while lowering.



## 10. Path to destination

Know where you are going. Have a clear path and the shortest distance to your destination. If you use carts, dollies, ladders, etc. make sure they are sturdy and in good repair. When using carts, hand trucks and dollies, push rather than pull.



## 12. Lowering same as lifting

If possible try to unload onto a surface that is waist high. If this is not possible, exercise extreme caution as the danger of injury increases as you move lower.



## STRETCHING EXERCISES

*All exercises should be done slowly and smoothly,  
avoiding jerking motions. Hold for 5 count.*

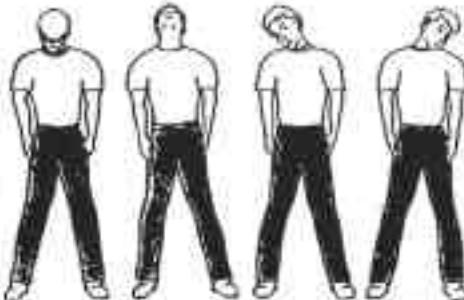
**Flexion:** Bend head down, chin to chest.

**Extension:** Bend head back, chin pointed up.

**Sidebend:** Tilt right ear to right shoulder.  
Tilt left ear to left shoulder.

**Rotation:** Turn chin toward right shoulder.  
Turn chin toward left shoulder.

### NECK

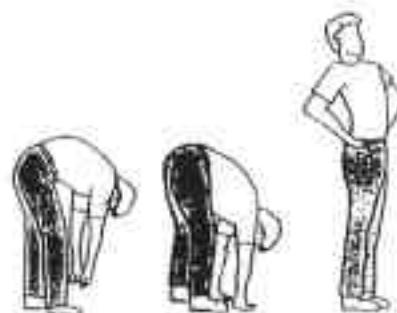


### SHOULDERS

Reach arms up above head, hold palms together. Keep arms up, turn hands to touch backs of hands together.

## Shoulder Blade Area

Reach across body with each hand holding the opposite shoulder (hug yourself). Tilt head and upper body forward. Hands around back of arms onto shoulder blade.



## Low Back (Flex / Extend)

Bend knees slightly, bend straight down, reach hands down as far as possible. Come back up to straight position, place hands on hips, and tilt body backwards.

## Leg Stretch (Calf / Thigh)

(1) Place left foot forward; right back, toes pointed straight ahead. Keep heels on the ground and lean forward to stretch calf. (2) Let heel come off ground, lean forward and press against raised foot to stretch upper thigh. Reverse position, stretch other side.



## Half Squat (Quads / Groin)

Spread legs, shoulders square with toe pointed out, with hands on knees, squat down half way. Keep back straight. Hold for 5 count.

## Low Back (Sidebend)

Reach right hand up over head. Tilt body to left, reaching left hand down to left knee. Reverse hand position and bend to right.

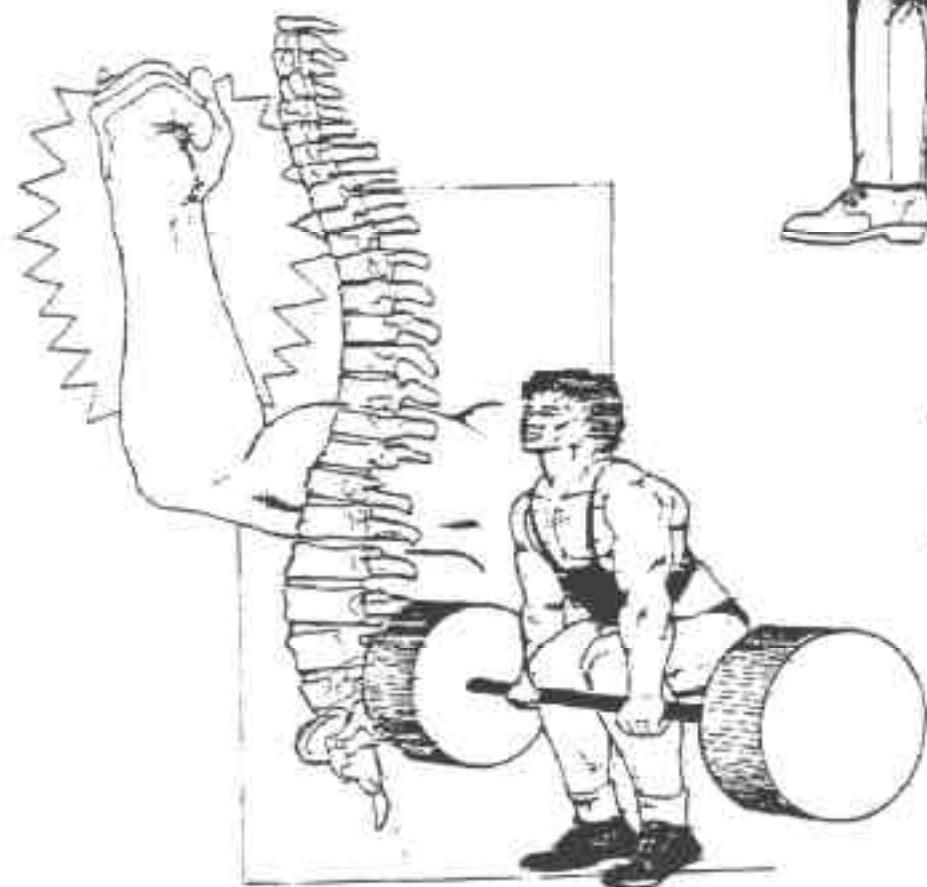


## Trunk Rotation

Place hands on hips, twist body to left, then to right as far as you can. Keep feet still.

Figure 6

# On the Road: The Lighter Side of Lifting



**Trainer's  
Manual**



**ENR Communications Inc.**

## *On The Road: The Lighter Side of Lifting*

### Summary

#### Subject

A way to lift that protects the back by limiting and distributing stress and exertion.

#### Running time

22 minutes

#### *This video...*

- Explains a better way to lift that stresses weight distribution, stance, and warming up and relaxing.
- Shows various types of lifting activities and how approach can alter strength, back stress, and efficiency.
- Motivates workers to think before they lift any object, whether heavy or light.
- Stresses the need for staying attuned to body position and work environment as a way of protecting the back.
- Gives you the chance to explain your policies on lifting and to discuss use of back supports, equipment, or other assistance you offer.
- Can be used for training new employees and for refresher training.

## Table of Contents

### **Trainer's Manual**

Subject information and set-up instructions for the person who will conduct the training on this subject.

### **Lesson Plan**

A customized step-by-step narrative script to assist the trainer in conducting the session. Includes suggestions for targeting your organization's special needs.

### **Participant's Manual**

A handout to be photocopied and distributed to persons attending the training session.

### **Participant's Quiz**

A quiz for employees to take after the training session. This page should be photocopied so each employee in the training session gets a copy. The quiz will help identify workers who need further assistance. The completed quiz can be collected and placed with the employees' records as further proof that they took part in the required training.

### **Answer Key**

An answer key to the employee quiz. This gives correct answers to the questions in the participant's quiz. This may be photocopied and distributed to employees at the close of training or may be used by the trainer as a reference tool.

## Trainer's Manual

*Before training begins. . .*

### Plan the session

Arrange for a location suitable for the training session. Ideally, the room should be comfortable and seat all participants in a quiet location. You should be able to darken the room to make viewing easier. The video monitor must be close to an electrical outlet and in a position where everyone can see it.

Reserve the audio/visual equipment and the video for the day and time needed. Check the equipment to ensure that it is in the proper format and in working order.

Read through all the materials in this manual, including the trainer's manual and the participant's manual. Be familiar with the subject and ready to answer questions, or arrange for an expert to join you during the training session.

Notify those you want to attend and their supervisors.

### Gather materials

Photocopy:

- A participant's manual for each participant.
- The participant's quiz, one for each participant.
- The answer key for the trainer. Copies of this may also be given to participants after they take the quiz.

*In addition,*

- Collect and review pertinent company policies related to the training. If you plan to distribute these to participants, you should make enough copies.
- Gather safety equipment or other items that will be part of a demonstration.
- Bring a wristwatch or clock to time the session.
- Provide pencils or pens for all participants.

### Final set-up

*Before the participants arrive on the day of training:*

- Set up the room so everyone can see the Trainer and video monitor. Include space for the trainer's materials.
- Distribute the materials, one set at each participant's seat.
- Insert and cue the video and check the sound level.

You're ready to begin the training.

## Lesson Plan

### Opening remarks (5 minutes)

#### ***Read or paraphrase the following.-***

"Today we are going to look at the subject of lifting. Go ahead, you can groan. But before you tune out, think about all the people you know with back problems. Few things are as uncomfortable and potentially disabling as a problem back. A sore back affects every move you make, from sitting to reaching to sleeping. And although years have been spent talking about protecting your back, back injuries still are rampant in every workplace. Let's face it. We've been teaching people how to lift for years and people still have back problems. Maybe it's time for a new approach."

Now explain the organization's policies and procedures related to lifting and back injuries. Remind participants that lifting safely will protect their backs and help them work safe and smart.

**Hint:** It is good to relate incidents in your workplace where lifting is done on a regular basis.

Also note how much reaching and lifting is done by people who have jobs that are not physically demanding. Ask participants to relate personal examples.

If you choose to share statistics on back injuries for your organization, this is a good place to mention them.

### Introduce the video

#### ***Read or paraphrase the following.-***

"We are now going to watch a video that takes a new look at lifting. Instead of all the rules that are so difficult to remember each time you reach, this video presents a simplified way of taking the load off your back. As you watch the video, try to think about how it relates to your work experience here."

### Show the video (22 minutes)

### Ask for questions

Answer any questions. Make sure you have an expert there if you think you might need one. If you don't know the answer, say so, but promise to get the answer and contact the person. Remember to do it.

### Demonstrations (10 minutes)

Set up several scenarios similar to those in the video: a box, a bucket on the other side of an obstacle, and a small package on the far side of a table. Ask participants to lift them using the information they learned in the video. Make sure to remind them to stretch and warm up first.

## On The Road: *The Lighter Side of Lifting*

Review generally your policies on lifting and when to get assistance, either human or mechanical.

If applicable, explain your policies on back supports and demonstrate their proper use. Review also your policies on reporting workplace injuries and/or accidents.

### Administer the safety awareness quiz and review it (10 minutes)

Ask the participants to complete the quiz that you distributed. Make sure they know that the quiz is not a condition of employment. It is a self-check of the points made in the session.

Review the quiz with the participants, giving them the correct answers from your answer sheet. Pass out answer sheets if you decided to do this. Then collect the quiz. It can be filed as evidence that training was completed.

### Closing remarks

*Read or paraphrase:*

"Thank you for your participation today. Remember that our backs don't come with owner's manuals. And that the most effective way to lift starts in our heads, not our backs. Lifting better is about thinking how you can minimize the demand of every lift you make.

"If you have any other questions, I will try to answer them or you can ask your supervisor."

Make sure you store the quizzes as documentation that the training was done.

## Participant's Manual

### What will work for our backs

Think about all the people you know with back problems. Few things are as uncomfortable and potentially disabling as an injured back. A sore back affects every move you make, from sitting to reaching to sleeping. And although years have been spent talking about protecting your back, back injuries still are rampant in every workplace.

Let's face it. We've been teaching people how to lift for years and people still have back problems. Maybe it's time for a new approach for taking the load off your back.

### The old approach

In the past, most discussions about how to lift centered around a long list of rules. Some of the more common lists included "approach the load" and "test the load" through "tighten the abdomen," and "lift with the knees." Yet for most people about to lift something, their most common thoughts are "Can I pick this up?" and "Where am I going to put it?" With so much to think about, no wonder so many people strained and even injured their backs.

### Back basics

The spine is composed of vertebrae with cushioning between that allows the spine to bend in several directions and twist. Its natural position is a slight "S" curve that begins at the neck and ends at the tail bone. The back is most comfortable in this position. It is also strongest and most functional in this shape. Stretching the back straight out or into a "C" shape are weaker positions and reduces the effectiveness of the cushioning disks.

There is also the effect of load. Every time a person bends into a "C" shape or flattens the back straight out, the load tends to be lifted from the hips. But the load in this position is not only the item being lifted, but also the entire upper body. It's as if the entire upper body is swinging out into thin air with nothing to support its weight. Then the weight of the item being lifted is added.

Lifting and bending in this way often results in back discomfort. It's one reason why people sometimes injure their backs when reaching to pick up a piece of paper or some other light object. They don't realize that the object actually being lowered and then lifted was their entire upper body and head! Not a light load at all.

That brings us to the two basic elements of this new approach to lifting:

- Keep the curves, and
- Keep it close.

If we can keep the curves in our spine as natural as possible and keep the load close to our bodies, we can reduce the strain on our backs and reduce the risk of back injuries. We'll also be working with the structure of our backs and bodies and with gravity, instead of against them. There are several ways to accomplish this.

## On The Road: *The Lighter Side of Lifting*

### Build a bridge

Many times when we lift we can take much of the load off our backs and put it someplace else. This is called building a bridge.

If an object can be lifted with one hand, we can lean the other hand on some solid object or on our flexed knee. Let the object or the knee support the weight of the upper body. This keeps our center of gravity, the place of our greatest body mass, more centered over where we touch the ground. It keeps our upper body mass from swinging out in midair with only our back to support it.

If two hands are needed for the lift, we can go down on one knee. This also keeps our center of gravity over our feet instead of in midair. This position can be much stronger and much more balanced than squatting over the object being lifted.

Building a bridge is one way of following the two elements of this lifting method: keep it close and keep the curves.

### Staggered stance

Another way to keep it close and keep the curves is to watch where you put your legs. Many people don't realize it, but how you stand has a lot to do with how you lift.

Keeping your legs close together forces your body to bend into a "C" shape at the lower back. On the other hand, separating your legs, with one forward of the other, gives a wider base of support and makes it easier for the legs to get involved in the lift.

The wide, staggered stance lowers your center of gravity and helps you keep the weight being lifted closer to your body. Your back moves very differently when your legs are further apart. You are more balanced. Your knees are flexed. And when you pick up an object in this position, it naturally stays closer to your body, your back stays in an "S" curve, and your head stays up.

Just remember that you also have to put down what you lift. Get into the habit of maintaining the wide, staggered stance when you put an object down as well as when you lift it.

### Prepare and compensate

Preparing to lift is an often forgotten concept. Yet warming up a body before doing physical work makes it operate much more efficiently.

Athletes do this routinely. They stretch and bend and get their muscles limber and warm before every game. They know that warm muscles are stronger and less easily injured.

Yet we often come to work and begin lifting without warming up. After sitting for hours, we get up from a desk and lift a box off the floor or reach for a telephone book without thinking. Placing a cold, stiff back and body in this position increases the risk of injury.

Compensation is also important. This means if you are placing repeated demands on your body you have to rest and relax it. The best way to do this is to change position

and stretch. If you are lifting a lot, stop for a few minutes and straighten your legs and back. Stretch from side to side and bend in the direction opposite from the way you were just bending.

Through preparing and compensating, we get our bodies ready before placing physical demands on them and we relax and stretch them frequently while we are working.

### Lifting better

Lifting is not about rules, or about a right or wrong way to perform each task. Lifting is about using our bodies in the most efficient way, in the way they work best. Therefore, the most effective way to lift starts in our heads, not our backs.

Lifting better is about thinking how you can minimize the demand of every lift you make-how you can keep the curves and keep it close.

## Participant's Quiz

Name

Date

Signature

Circle True or False for each of the statements below.

1. - Lifting is not about rules but about using our backs in their strongest and most natural positions.  
True      False
2. Keep it close and keep the curves are two key points to remember when lifting.  
True      False
3. Never use anything to support your weight when lifting. Your back should be trained to do all the work.  
True      False
4. Standing with the legs separated and with one leg in front of the other makes lifting easier by shifting some of the weight from your back to your legs.  
True      False
5. Warming up your body before lifting objects prepares it for work and is one way to reduce the risk of back injuries.  
True      False
6. To compensate our bodies for repeated lifting we should take a long lunch.  
True      False

## Answer Key

1. True. Lifting is not about rules but about using our backs in their strongest and most natural positions.
2. True. Keep it close and keep the curves are two key points to remember when lifting. When we keep the load close to our bodies we keep it closer to our center of gravity and more directly over the point where our body touches the floor. When we keep the curves in our back, we reduce the strain on the muscles and allow the back's natural cushioning disks to work more effectively.
3. False. Supporting the weight of your upper body when lifting helps take the strain off your back muscles. It also helps maintain the natural curve of the back and keeps you from swinging your upper body weight into midair without anything but your back to support it.
4. True. Standing with the legs separated and with one leg in front of the other makes lifting easier by shifting some of the weight from your back to your legs. It also helps keep your center of gravity lower and keeps the back in its more natural and stronger position.
5. True. Warming up your body before lifting objects prepares it for work and is one way to reduce the risk of back injuries. Stretching, bending, and moving your muscles are ways to warm up.
6. False. To compensate our bodies for repeated lifting we should stretch and move our muscles into the opposite position. We should take a minute to straighten up our legs and backs. Bend and stretch from side to side. Taking a new position for a minute allows our muscles to relax.

Figure 7



**Cable Puller  
with Versi-Boom™  
System**



**GREENLEE TEXTRON**



Figure 7

# Cal-OSHA Reporter™

Since 1973

A WEEKLY PUBLICATION FOR THE SAFETY AND HEALTH COMMUNITY

September 8, 1997

Vol. 24 No. 36

## IT'S OFFICIAL - IT'S JEFFRESS

President Clinton has announced his intent to nominate Charles N. Jeffress as Assistant Secretary for Occupational Safety and Health at the U.S. Department of Labor.

Jeffress has served as deputy commissioner and director of OSHA at the North Carolina Department of Labor since 1993. He is widely credited with rebuilding the state program after the deadly fire at a chicken processing plant. (Many workers died because exit doors were locked. There had never been a safety compliance inspection there. At the time, OSHA threatened to federalize the state plan.)

From 1977 to 1992, Jeffress served as assistant commissioner in the North Carolina Department of Labor. He is a graduate of UNC - Chapel Hill.

## LOS ANGELES DWP DEFENDS ITS SAFETY PROGRAM

COR received the following statement in response to an article based on a series that ran in the Workers' Comp Executive (see NEWS p. 00-6735):

The August 18, 1997 issue of *Cal-OSHA Reporter* contained some information regarding the Los Angeles Department of Water and Power (LADWP) that is inaccurate. Specifically, statements that LADWP's safety staff is down to one person and people are getting hurt on the job due to downsizing are simply not true.

LADWP has and will continue to place the highest priority on employee safety. This is evidenced by an average lost workday injury rate of 2.1, which is reported to be well below the public utility industry average of 5.7 days.

This past July, as part of our ongoing reorganization to prepare for deregulation, we established a new Corporate Safety and Environmental Compliance Business Group (CSEC), reporting directly to the General Manager. Henri E. Cierpich, who was cited in your August 18, 1997, issue, is part of this new organization. CSEC is responsible for corporate safety policy, interfacing with regulatory agencies, performing facility safety audits, and providing an independent third party review of accident investigations. CSEC will track overall safety statistics, establish corporate-wide safety standards, and monitor individual business unit safety performance.

Each business unit is accountable for its employees' safety, and will tailor individual programs to suit specific

worker safety requirements. The details of a particular business unit's safety program, including which elements are implemented and which receive the greatest emphasis, are decisions left to the business unit.

"As we prepare for a deregulated environment, we want to keep in mind that our employees are our most important assets and no job is so important that we cannot take the time to do it safely."

—Signed: Michael A. Reavis, Director of Corporate Safety and Environmental Compliance

## SOME SOLUTIONS FOR ACHING BACKS

**NURSING HOME METHODS:** Because of large numbers of back injuries, nursing homes are ranked high on the list of high hazard industries. A pilot project at a nursing home in the San Francisco area has greatly reduced the number of back injuries among nursing aides. UCLA's Labor Occupational Safety and Health Program (LOSH) and the Vale Health Care Center in San Pablo began to work together a year ago on injury prevention. Their goal was to help aides learn how to lift or move patients in back-friendly ways.

At Vale, there were about 10 back injuries every year among the 70 aides. LOSH put nursing aides through two injury-prevention training sessions that lasted 3 1/2 hours each. A labor-management committee was set up to review injury problems. And Vale replaced some of its old, awkward patient lifting systems with two electrically powered \$4,000 machines that were easier to use.

Valerie Paynter, Vale's staff director, said the new equipment already appears to have paid for itself. She told the *Los Angeles Times* the company's workers' compensation expenses from

## IN THIS ISSUE

NEWS	(00-6749 to 00-6752)
•Cal-OSH Standards Board's August Meeting	
•6-Day Metro Rail Yellow Tag	

DECISIONS (40-3381 to 40-3382)

FILED INSTRUCTIONS: File pages 00-6749 to 00-6752 behind page 00-6748 following the NEWS tab. File Decisions pages 40-3381 to 40-3382 behind page 40-3380 following the DECISIONS tab.

panier handling incidents totaled nearly \$30,000 over 1995 and 1996. So far, there has been only one back injury this year, and it happened to a worker who wasn't using one of the new lifts.

Vale plans to try two more of the new lifts. GranCars Inc., a garment company, is beginning similar programs at two of its other Bay Area laundry facilities.

Project director for LOSH is Diane Fazio. The key, she said, is to support both workers and management.

#### BACK BELTS FOR HOME HEALTH CARE WORKERS

The Southern California Injury Prevention Research Center hit the national news last year with its study of Home Depot employees' back belt use. Injuries were reduced by 34 percent over six years, with the greatest effect observed on employees classified as heavy lifters.

The center is now doing another back belt study, this one in New York with 32,000 home health care workers. This is a prospective, controlled study. Once there are some results, Dr. David McArthur promised to share them with COR.

#### BACK SCHOOL WAS A BUMMER FOR POSTAL EMPLOYEES

Back care classes that offer instruction in proper lifting techniques and exercises for strengthening back muscles are often recommended to reduce injuries. Researchers at Brigham and Women's Hospital in Boston led by Lawrence H. Dallaloy wanted to test the efficacy of the approach. They set up a back school for postal workers at two large mail processing centers. Therapists put on two three-hour training sessions for small groups of mail handlers, clerks and supervisors. They all got three or four refresher courses over three years.

In all, 2,664 employees went to back school. A similar number of untrained workers were followed for the same period. During 4 1/2 years of follow-up, 36 workers suffered back injuries, but there was no significant difference between those who got the training and those who did not. The number of lost workdays and the cost of the injuries was the same.

"I think [back schools] can be very useful for individual

people who already have back pain, but not as blanket training for everybody at a work site," Dallaloy said. "Our money can be better spent doing other things," such as redesigning workplaces and making it easier for workers to return by giving them less strenuous light duty jobs until they heal.

The results of the study appeared in the July 31 issue of the *New England Journal of Medicine*. The cost of the article is available for \$10 by calling 800-843-6356.

#### Cal-OSHA STANDARDS BOARD'S AUGUST MEETING

The August 21 public meeting and hearing of the Cal-OSHA Standards Board was brief, COR was told. The board first heard public comments about changes proposed for two sets of Construction and General Industry safety orders.

##### ERCTION OF STRUCTURES

Four sub-subsections of §1710(g) were modified to clarify that references to working and traveling on the skeleton steel of multi-story buildings will apply only to ironworkers, not other employees. The Division of Occupational Safety and Health (DOSH) requested the change after a carpenter at a Lusardi Construction Company site fell 24 feet to his death.

Construction §1670(a) requires personal fall protection for employees exposed to a fall of more than 13 feet, and DOSH cited under that subsection. Lusardi argued that all employees working and traveling along skeleton steel—not just steel workers—were subject to the 10-foot requirements of §1710(h). The employer contended the crane all the way to district court level, unsuccessfully. DOSH hopes the change will clear up any confusion.

Steven Cooper, Ironworkers International, spoke in favor of the change. He offered some other suggestions, but was told they were outside the scope of §1710(g). Chairman Jerry Ingram suggested that he submit a petition.

**REBAR.** By letter, Safety Director Herb Higgins of Regional Steel Corporation in Claremont, CA, said he was a rebar

#### Cal-OSHA Reporter

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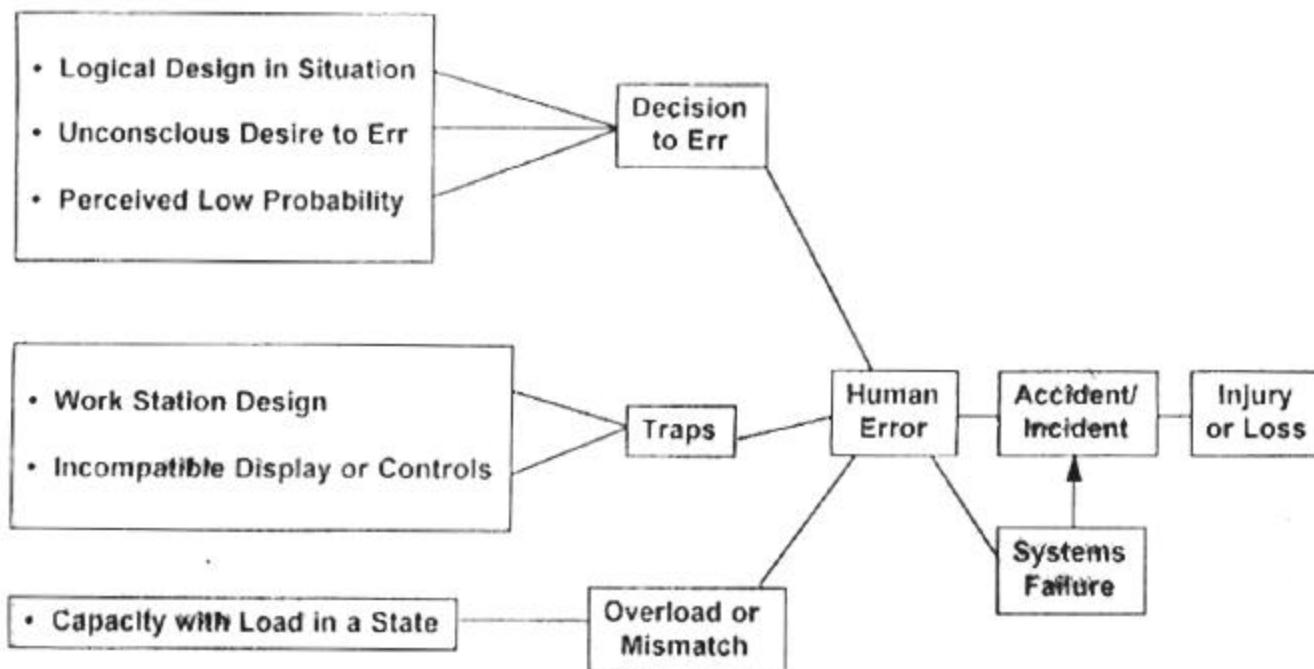
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### ACCIDENT/INCIDENT CAUSATION MODEL

Figure 9



Dan Petersen, Human Error Reduction, 1981

**PHASE PROCESS IN UNDERSTANDING THE  
CONTROL OF OCCUPATIONAL INJURIES & ILLNESS**  
HOPWOOD - 12/93

PHASE I (REC)	PHASE II (EMP)	PHASE III (PAT)	PHASE IV APPLICATION & TEST
<b><u>RECOGNITION</u></b> (Existence)	<b><u>EQUIPMENT</u></b>	<b><u>PHYSICAL</u></b>	
<ul style="list-style-type: none"> <li>• observation</li> <li>• scientific study</li> <li>• experience</li> <li>• anecdotal</li> <li>• legislative</li> </ul>	<ul style="list-style-type: none"> <li>• selection</li> <li>• use</li> <li>• maintenance</li> </ul>	<ul style="list-style-type: none"> <li>• separation</li> <li>• distance</li> <li>• shielding</li> <li>• process</li> </ul>	
<b><u>EVALUATION</u></b> (Magnitude)	<b><u>MATERIAL</u></b>	<b><u>ADMINISTRATIVE</u></b>	
<ul style="list-style-type: none"> <li>• sample</li> <li>• measure</li> <li>• costs</li> <li>• #/frequency</li> </ul>	<ul style="list-style-type: none"> <li>• selection</li> <li>• use</li> <li>• maintenance</li> </ul>	<ul style="list-style-type: none"> <li>• rotation</li> <li>• time</li> </ul>	
<b><u>CONTROL</u></b> (Reduction/Maintenance)	<b><u>PEOPLE</u></b>	<b><u>TRAINING/EDUCATION</u></b>	
<ul style="list-style-type: none"> <li>• Physical</li> <li>• Administrative</li> <li>• Training (&amp; Education)</li> </ul>	<ul style="list-style-type: none"> <li>• selection</li> <li>• use</li> <li>• training</li> </ul>	<ul style="list-style-type: none"> <li>• training</li> <li>• education</li> </ul>	

\* These two have a down side - they do not change the hazard

Figure 10

## THE USE OF THE AIR BELT™ IN INDUSTRY

Safeguard Technologies  
October 1994

### Seven years + Sixteen million belts = Confusion

**FACT:** people are applying many different back belt products in many different ways, with very different results. The answers to how well they work, are all different, too.

A recent Back Belt survey in various sectors of the economy shows from the 300 respondent companies that

65% supply back belts  
42 % of those who supply belts have a program  
75 % of those with a program report a reduction in back claims

The survey also shows why we are confused:

35 % do not supply back belts  
58% of those who supply belts don't have a program  
25% of those with a program do not have positive results.

### NIOSH POSITION BULLETIN

Industry has expressed much concern over the memo of August 5, 1994. It is not all bad news, many of their comments make sense. For example, who would argue with their statement "The most effective way to prevent back injury is to redesign the work environment and work tasks to reduce the hazards of lifting." However, is that position always attainable, practical, cost effective? What about workers who hurt their backs by sports injury or tasks unrelated to lifting? Many of the naysayers of back belts admit the use of back supports seems to benefit this group. These are the individuals who, frankly, account for most of the costs associated with back injury.

The confusion seems to be focused on the effectiveness of belts by healthy workers. Interestingly, many of the corporations who claim successful Back Injury Prevention Programs, use back supports. Reference to the statistics noted above for the three hundred companies.

## **CONCERNS FROM RESEARCHERS**

There seems to be an apparent lapse of consistent application of criteria when reviewing research. Bias becomes quickly evident. We must evaluate information carefully, perhaps seeking assistance when attempting to understand data and conclusions. In a recent summary of papers reviewing positive and negative studies on back supports, the reviewer notes that he did not include many studies in his paper because they had no matched control group, no post-trial sample size, etc. Yet, in the clinical trials cited, virtually none of these criteria are met.

And, unfortunately, there was no scrutiny of practical issues, such as the appropriateness of a wide, stiff belt used in the 42 inch belly of an airplane to load luggage. The researcher in that study indicates 58% of the workers discontinued wearing the belt prior to the end of the project. We constantly hear this study cited as a case against back supports. Shouldn't the conclusion be that certain styles of belts are not appropriate in certain situations. Training should include a choice of belt to use. Isn't that true of hearing protectors, safety shoes, and respirators.

*The reasons people have for not using back belts do not apply to using the Air Belt™*

- ***Back belts weaken muscles.***

The Air Belt™ does not weaken muscles, it does not reduce any range of motion or do the normal work of back muscles.

- ***Back belts only remind the user to lift properly.***

Lifting properly or working smarter is a function of training. Reminding is a positive reinforcement of training. Safety products do remind, but valued products have their own functionality. The Air Belt™ helps to eliminate unwanted lower back contractions. This will reduce fatigue and residual back pain that will occur if unwanted contractions from work go unchecked. The Air Belt™ helps maintain proper posture by placing pressure on shortened muscles, allowing them to return to their normal resting length to promote proper spinal alignment. This alignment is often expressed as keeping your head and shoulders over your hips. This alignment should be stressed when lifting, standing or even when you are seated.

- ***Back belts cause a false sense of security.***

The need for ongoing training and understanding of the product cannot be overstated. ***Safeguard Technologies*** can assist you by providing training aides, fitting belts, addressing safety and ergonomic committee meetings.

For example, hard hats can't really prevent many injuries by themselves. A "*Hard Hat Area*" program prevents tools and material from falling, makes head height obstacles avoidable, and prominently displays signs to alert potential danger and remind people to follow the rules. A "*Hard Hat*" alone does not prevent head injuries, as well as when a comprehensive program is implemented.

If you agree the cost of preventing a back injury is less than the cost of a back injury, then this is what you need to do:

***Make a commitment*** to participate and contribute to a program that takes action to reduce back injuries.

***Set up an effective safety program*** with effective safety products for predictable positive results.

***Don't Compromise*** - if either the product or the program is compromised, the results are compromised.

A back injury prevention program in combination with the Air Belt<sup>TM</sup> back supports has been shown to produce better results than either approach utilized separately.

The program approach is very important, it can reduce back injuries by making the work place more ergonomically correct, and the worker work smarter. The Air Belt<sup>TM</sup> is very important, it can reduce and help prevent lower back pain that is caused by some types of work.

## **THE PROGRAM AND THE AIR BELT™ PREVENTS BACK INJURIES**

### **Commitment**

A pro-active commitment to reducing back related injuries is the most important element of a successful program. A Win/Win decision. This commitment must start at the top of the company organization and must be transmitted to every employee.

### **Identification**

Identify the kind of job that often contributes to lower back injury. Identify tasks where frequency, bulk and weight exceed NIOSH targets. Identify individuals who have suffered a previous back injury, they are four times more likely to re-injure themselves than those who have not had a previous back problem.

### **Availability**

Make Air Belts™ available to those individuals who would like to use them. Allow individuals to choose between 2 or more Air Belt™ models so their personal needs are met, and their "buy-in" to the program is present.

### **Training**

People need to know how the Air Belt™ can lessen the risk of back injury by reducing unwanted muscle contraction. By reducing unwanted muscle hypertonicity, Air Belt™ can help maintain the lordotic curve of the lower back, desirable in lifting and seated postures. They need to know the Air Belt™ will not weaken muscles, because it does not deny range of motion or do the work of the muscle groups. And, it won't help anyone do anything extraordinary. Each belt has a warning label indicating this fact. Safeguard's training video also reinforces this message. Sessions on safe lifting techniques, physical conditioning, and the benefits of good posture are all part of ongoing training.

### **Ergonomic Evaluation**

Establish a task force, develop action plan, analyze work site and work practices, assess employee capabilities, define possible changes, prioritize actions, and measure results. The evaluation should involve the input of all employees.

### **Medical Surveillance**

Individual physical capabilities should be determined to establish if they are able to perform specific tasks over the expected duration.

**The following reference information may be helpful; most are specific to our patented pneumatic back belt products:**

Your safety products sales representative can send any of the following studies

**"AirBelt. Initial Clinical Experience". Prevention of Reoccurrence of Back Injury in High Risk Group of Workers".** Peter R. Sebastian, D.O., board certified neurologist

**Rehabilitation Study, "Acute and Chronic Effects of Pneumatic Lumbar Support on Muscular Strength, Flexibility, and Functional Impairment Index",** which demonstrates effectiveness of Air Belt™ in treating back injury. Keith W. Penrose, Ph.D., Kumkay Chook, MD, John L. Stump, DC, and MS Sports Medicine

**"Effects of Lumbar Belts on Trunk Muscle Strength and Endurance",** compared daily use of soft, flexible belt versus traditional weight lifters belt in construction industry. Eve Holmstrom and Ulrich Montz, Department of Physical Therapy, University of Lund, Sweden

**"Back Injury Prevention Pilot Program, Philadelphia Electric Company",** report summary covers 472 workers who were evaluated by control group, training only, Air Belts™ only, training and Air Belts™, the later achieving both decreases in severity and frequency of back injury. John F. McLaverty CIH, CSP

**"Muscles, central nervous motor regulation and back problems",** specific pages of this report indicate the desirability of relaxing tightened back muscles before attempting to use or strengthen abdominal muscles. Dr. Vladimir Janda

**"Clinical Anatomy of the Lumbar Spine",** downward direction of the action of the back muscles as they contract exert a longitudinal compression of the lumbar vertebral column. The Air Belt™ works to decrease the electrical activity of these muscles, therefore being a more likely protector of axial compression loads. Bogduk and Twomey

**"The Minimum Abdominal Belt Aided Lifting Weight",** statistically significant differences were found in the measurement of erector spinal and external oblique integrated EMG's, moment impulses, and low back force impulses, the Air Belt™ providing the best results for these parameters during the critical phases of lifting. Thomas Hilgen, Masters Thesis, Auburn University

**Back Belt Market Analysis and Report** available from:  
John Alden Associates, P.O. Box 51, Holden, MA 01520  
(508) 853-1858  
(estimated cost \$220)

In addition to the studies listed, letters from professional sports team athletic trainers, and testimonials from industrial safety managers are available.

We can arrange for your doctor or therapist to talk with a peer who has experience with Air Belt<sup>TM</sup> products.

The most compelling information is not from studies

It is from someone you know

Someone who knows the Air Belt<sup>TM</sup> works for them

### *Starting a Program*

We can work with you to establish a pilot program. The pilot requires the essential elements of a Back Belt Program for reasonable evaluation. The pilot should target the type of work that seems to contribute to back pain.

We can provide the appropriate sample of Air Belt<sup>TM</sup> products, or any of our other comfortable hand, wrist, elbow, foot, ankle, knee, and body protective products for your considerate evaluation.

Air Belt<sup>TM</sup> and Air Flex<sup>TM</sup> are registered trademarks of

**Safeguard Technologies**  
**1-800-Air-Belt**